

# Municipal Journal

Volume XLI.

NEW YORK, OCTOBER 5, 1916

No. 14

## BITUMINOUS MACADAM AND BITUMINOUS CONCRETE PAVEMENTS

The Latest Opinions of Recognized Authorities on the Materials and Methods Requisite for the Most Successful Construction and Maintenance.

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Before proceeding with the discussion of bituminous macadam and bituminous concrete pavements, it is advisable, in order to avoid misunderstandings, to quote the definitions of the two types of pavements as recommended by the Special Committee on "Materials for Road Construction" of the American Society of Civil Engineers:

**Bituminous Macadam Pavement.** One having a wearing course of macadam with the interstices filled by penetration methods with a bituminous binder.

**Bituminous Concrete Pavement.** One composed of stone, gravel, sand, shell, or slag, or combinations thereof, and bituminous materials, incorporated together by mixing methods.

### GENERAL

Certain features of construction which are common to both classes of bituminous pavements will be discussed prior to considering details which specifically refer to each of the several types.

**Foundations.**—There has been a general acknowledgment of the ultimate economy of constructing adequate foundations to support the amount and character of traffic which the several types of bituminous pavements are able to carry. In the case of bituminous macadam pavements, this development usually has been characterized by the construction of well-compacted and, in many cases, thoroughly filled broken-stone foundations. In the case of bituminous concrete pavements, due to numerous failures which have occurred where this type of pavement has been built on old macadam or poorly constructed broken stone foundations, there has been a general tendency to advocate the use of cement-concrete foundations from four to six inches in thickness. It has generally been found that the cost of cement-concrete foundations does not exceed the cost of thoroughly compacted and well filled broken stone foundations of equivalent strength. Furthermore, the use of cement-concrete foundations renders repairs and renewals more satisfactory and much easier of accomplishment.

**Non-Bituminous Highway Materials.**—There has been a general recognition since 1914 of the desirability of covering in specifications in more detail and with greater rigidity the physical properties of the aggregates to be employed and the sizes of the particles which compose such aggregates. For example, the 1914 Specifications of the American Society of Municipal Improvements covering bituminous macadam pavements, state, with reference to the physical properties of the stone, that the rock employed must meet the following requirements:

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The broken stone shall be subjected to abrasion tests and toughness tests, conducted by the engineer, in accordance with methods adopted by the American Society for Testing Materials, August 15, 1908. The broken stone used for the construction of the first and second courses shall show a French coefficient of wear of not less than 7.0 and its toughness shall be not less than 6.0. The broken stone used for the construction of the third course and for the first and second applications of No. 1 broken stone, shall show a French coefficient of wear not less than 11.0 and its toughness shall not be less than 13.0.

The necessity for more carefully drawn specifications covering the sizes of the particles of which a given product of a stone crushing and screening plant is composed, is illustrated by the following mechanical analyses of two products obtained from the same plant, both of which products passed over a section of a rotary screen having circular holes of one and one-fourth inches and through a section of a rotary screen having circular holes two and one-fourth inches in diameter.

		Sample "A"	Sample "B"
		Per cent	Per cent
Passing	1/4 inch screen	0.2	0.1
"	3/4 " "	0.1	0.1
"	1/2 " "	0.4	1.1
"	3/4 " "	2.2	12.6
"	1 " "	8.0	37.5
"	1 1/4 " "	29.1	40.9
"	1 1/2 " "	27.1	7.7
"	2 " "	32.9	0.0
		100.0	100.0

It is hence obvious that for many forms of bituminous construction, in order to secure successful results, greater care must be used in the writing of specifications for products of broken stone.

As an illustration of an improvement in specifications covering this detail, there is cited those adopted at the 1915 Convention of the American Society of Municipal Improvements, covering broken stone to be used for the aggregate of one type of bituminous concrete pavement:

Broken stone for the mineral aggregate of the wearing course shall consist of one product of a stone crushing and screening plant. It shall conform to the following mechanical analysis, using laboratory screens having circular openings: All of the broken stone shall pass a one and one-quarter (1 1/4) inch screen; not more than ten (10) per cent nor less than one (1) per cent, shall be retained upon a one (1) inch screen; not more than ten (10) per cent, nor less than three (3) per cent shall pass a one-quarter (1/4) inch screen.

It is noted that in this form of specifications an attempt is made to cover in the mechanical analysis only the limits of the smallest and largest particles. No attempt is made to secure a carefully graded aggregate,

but simply a product suitable for the type of pavement in question and uniform in character. For example, the following mechanical analysis show three products used in the successful construction of three different bituminous concrete pavements of the type mentioned:

		Sample "A"	Sample "B"	Sample "C"
		Per cent	Per cent	Per cent
Passing	1/4 inch screen	1.2	2.7	1.0
"	1/4 " "	4.2	5.6	2.5
"	1/2 " "	34.7	45.0	30.8
"	3/4 " "	40.6	35.1	34.2
"	1 " "	17.3	10.1	23.4
"	1 1/4 " "	2.0	1.5	8.1
		100.0	100.0	100.0

In its 1916 Report, Committee D-4 on "Standard Tests for Road Materials," American Society for Testing Materials, recommended the general adoption of the following "Proposed Standard Form of Specifications for Certain Commercial Grades of Broken Stone":

The broken stone shall consist of one product of the operation of a stone-crushing and screening plant without recombining or mixing, and shall conform to the following mechanical analysis using laboratory screens:

Passing screen having smallest holes selected. From .... to .... per cent.

Passing screen having next to largest holes selected. From .... to .... per cent.

Passing screen having largest holes selected. From .... to .... per cent.

Example:—The broken stone shall consist of one product of the operation of a stone-crushing and screening plant without recombining or mixing, and shall conform to the following mechanical analysis, using laboratory screens:

Passing 1/4-in. screen ..... 3 to 10%

Passing 1-in. screen and retained on 1/4-in. screen ..... 80 to 95%

Passing 1 1/4-in. screen and retained on 1-in. screen ..... 2 to 10%

Total passing 1 1/4-in. screen ..... 100%

Or the analysis may be expressed as follows:

Total passing 1/4-in. screen ..... 3 to 10%

Total passing 1-in. screen ..... 90 to 98%

Total passing 1 1/4-in. screen ..... 100%



FIG. 1. IMPROPER METHOD OF REPAIRING BITUMINOUS PAVEMENT WITH COLD ASPHALTIC OIL AND STONE CHIPS.

**Bituminous Materials.**—There has recently been considerable discussion pertaining to the advisability of the adoption of so-called "alternate type" specifications in preference to the so-called "blanket" specifications for bituminous materials. By alternate type specifications is meant a series of specifications, each of which covers the physical and chemical properties of the most desirable grade of a given type of bituminous cement for the pur-

poses for which it is to be used. On the other hand, a blanket specification covers in one set of requirements, pertaining to physical and chemical properties, all the types of asphalt or tar cement which are to be used in connection with the construction of a given kind of pavement. For example, in the case of specifications for asphalt cement for bituminous concrete pavements, it would be desirable under alternate type specifications to have not less than five sets of physical and chemical requirements, the limits for each requirement being as narrow as the several processes of manufacture would permit; while on the other hand, a blanket specification would cover with a wider range of limits the same chemical and physical properties of the five types mentioned. As an illustration will be cited the limits in the cases of Specifications "A" to "E" inclusive, under the alternate type specification method for specific gravity, and the penetration at 25° C. (77° F.)

	"A"	"B"	"C"	"D"	"E"
Sp. Gr.....	0.97-1.00	1.00-1.03	1.03-1.04	1.025-1.05	1.04-1.06
Pen't. ....	75-90	90-100	70-90	85-95	140-160

In the case of a blanket specification to cover the same grades of the several types, the limits for specific gravity would have to be 0.97 to 1.06 and the limits for penetration would be 70 to 160. The penetration test, for example, can only be of maximum value when applied to the grade of a specific type of bituminous cement which is most suitable for the type of pavement in question. In the case of the bituminous concrete pavement of the type mentioned, the proper penetration limits for a California asphalt lie between 70 and 90, while for a fluxed Bermudez asphalt to be used in exactly the same type of pavement and under the same conditions, the penetration limits should be between 140 and 160. It is evident that an attempt to cover the penetration limits for both materials in one specification is impracticable. In the first place, such limits as 70 to 160 are so wide as to insure but little uniformity in different lots of the same material; and in the second place, an entirely unsuitable material of one class could be supplied under the maximum or minimum test limits of the other class.

The proper use of alternate type specifications allows the contractor to bid to supply so many tons of bitumen which will comply with any one of the sets of requirements. It will be noted, therefore, that the contractor



FIG. 2. PROPER METHOD OF REPAIRING BITUMINOUS PAVEMENTS WITH BITUMINOUS CONCRETE.

is in exactly the same position as in the case when he bids to supply any asphalt cement which will comply with the requirements of a blanket specification.

**Guarantees.**—There has been a general tendency to abandon the use of guarantees on bituminous pavements, as it is believed that, with proper specifications and efficient supervision and inspection, guarantees are not necessary and that the requirement of a guarantee materially increases the prices bid on a given pavement. The subject of guarantees is too broad to discuss in this paper,



but it should be noted that under the title "The Economics of Guarantees of Pavements on State and Municipal Highways," it has been admirably treated by George C. Warren in a lecture in the graduate course in highway engineering at Columbia University, which lecture has been published under the auspices of the National Highways Association, Charles Henry Davis, president.

**Maintenance.**—The maintenance of many bituminous macadam and some bituminous concrete pavements requires removing fat spots where uneven distribution has caused an excess of bituminous material to exude on the surface. Such fat spots may be effectively repaired by removing the excess of bituminous material with a hoe or sharp-edged shovel and covering the surface thus exposed with a thin dressing of Portland cement. In some cases it may be necessary to use a light covering of sand or stone chips. Light oils and light tars should never be used for repairing holes (see Fig. 1), as the patches thus formed will not be stable and hence will soon be displaced by traffic. Places which disintegrate should be cut out with perpendicular sides and refilled with either a mixed aggregate (see Fig. 2), or by building up the hole with successive layers of road metal and bituminous cement such as is used in the construction of bituminous macadam pavements, the former method, however, giving the better results. At intervals it has been found economical to renew the bituminous surface by using from  $\frac{1}{4}$  to  $\frac{1}{2}$  gallon per square yard of the proper type of bituminous cement. Experience in many parts of the country has fully demonstrated that the patrol system of maintenance is most efficient and economical and that by this method the maximum life of the pavement will be ensured.

#### BITUMINOUS MACADAM PAVEMENTS.

In addition to the improvements noted above, the most notable recent development in the construction of bituminous macadam pavements has been in connection with the compaction of the road metal and the distribution of the bituminous materials.

As a result of the numerous failures of bituminous macadam pavements which have occurred due to the improper rolling of wearing courses of road metal prior to the application of bituminous material, there has been a general recognition of the necessity for more thorough compaction of the road metal. This principle has been recognized by the special committee on "Materials for

minous materials in quantities of more than two and one-half gallons per square yard, where the upper course of the macadam is to be three inches in thickness after compaction; is inadvisable under the penetration method.

There has been a general recognition of the advisability of using properly designed distributors in connection with the application of bituminous materials in order to secure uniform distribution economically. Some specifications cover the requirements which a distributor must meet. For example, the 1914 specifications of the American Society of Municipal Improvements contain the following paragraph pertaining to the pressure distributor:

The pressure distributor employed shall be so designed and operated as to distribute the bituminous materials specified uniformly under a pressure of not less than twenty (20) pounds, nor more than seventy-five (75) pounds per square inch, in the amount and between the limits of temperature specified. It shall be supplied with an accurate stationary thermometer in the tank containing the bituminous material and with an accurate pressure gauge so located as to be easily observed by the engineer while walking beside the distributor. It shall be so operated, that at the termination of each run, the bituminous material will be at once shut off. It shall be so designed that the normal width of application shall be not less than six (6) feet, and so that it will be possible on either side of the machine to apply widths of not more than two (2) feet. The distributor shall be provided with wheels having tires, each of which shall not be less than eighteen (18) inches in width, the allowed maximum pressure per square inch of tire being dependent upon the following relationship between the aforesaid pressure and the diameter of the wheel: For two (2) feet diameter wheel, two hundred and fifty (250) pounds shall be the maximum pressure per linear inch of width of tire per wheel, an additional pressure of twenty (20) pounds per inch being allowed for each additional three (3) inches in diameter.

This specification provides for a distributor by which it is practicable, under competent supervision, to secure uniform application of the bituminous material and allows the use of a pressure distributor without danger of rutting of the wearing course of broken stone by narrow tires carrying excessive weights.

**Causes of Failure.**—The causes of failure of bituminous macadam pavements may be considered under the following heads, bituminous cement and methods of construction.

Unfortunately many are the instances where unsuitable bituminous materials have been employed. Many engi-



FIG. 3. FAILURE OF BITUMINOUS MACADAM PAVEMENT DUE TO USE OF UNSUITABLE BITUMINOUS MATERIALS.

Road Construction" of the American Society of Civil Engineers in its 1915 Report, the conclusion referred to reading as follows:

An important factor for successful results is the proper compaction by rolling of the road metal before the spreading of the bituminous material.

The above committee emphasizes another improvement which is aimed at the use, in some cases, of an excess amount of bituminous cement in this type of pavement. This conclusion is as follows:

Present indications are to the effect that the use of bitu-

neers having charge of bituminous work do not appreciate the fact that different types of bituminous materials have entirely different physical properties and require entirely different treatment in use, although they may have been purchased under one and the same specification covering chemical and physical properties. In some cases entirely unjustifiable combinations of materials are employed. For instance, in one case an asphalt of excellent characteristics was used for the first application, while for the second application an asphaltic oil having decidedly solvent and fluxing properties was employed.

The result is shown in Fig. 3. Overheating of the material has likewise proved the cause of many failures, as the properties of the materials are sometimes changed and in many cases the materials are ruined.

Insufficient rolling has caused many failures. Others are due to the uneven distribution of the bituminous material in some cases when horse-drawn or power-driven distributors are employed. This type of failure, however, is more frequently due to the improper use of hand-pouring pots and hand-drawn distributors. Many unsatisfactory bituminous macadam pavements result from the use of the wrong sizes of broken stone. Failure due to the rapid formation of fine cracks caused by the rocking movement of the individual stones under traffic, finally resulting in ravelling and general disintegration, are of common occurrence. Segregation of sizes of stone preventing uniform penetration results in "lean" or weak spots in some cases and "fat" spots in others (see Fig. 4). In certain cases after a rain the construction has been carried on before the broken stone immediately below the surface has dried out (see Fig. 5).

#### BITUMINOUS CONCRETE PAVEMENTS.

The improvements in the construction of bituminous concrete pavements, to which attention should be called, will be considered under the following classification of the three types into which bituminous concrete pavements generally may be divided. These types are designated as follows:

A. A bituminous concrete pavement having a mineral aggregate composed of one product of a crushing and screening plant. (See Figs. 6 and 7.)

B. A bituminous concrete pavement having a mineral aggregate composed of a certain number of parts by weight or volume of one product of a crushing and screening plant and a certain number of parts by weight or volume of fine mineral matter such as sand or stone screenings.

C. A bituminous concrete pavement having a predetermined mechanically graded aggregate of broken stone or gravel, either alone or combined with fine mineral matter, such as sand or broken stone screenings.

*Patents.*—Unfortunately, the present status of patent litigation has to be considered in connection with the discussion of the several types of bituminous concrete pavements. The majority of engineers and highway officials are interested in the types of bituminous concrete pavements which may be constructed without danger of litigation rather than in a prolonged discussion of the probabilities of successfully defending suits for infringement. There is ample evidence at hand that bituminous concrete pavements of type A may be constructed without danger of litigation proceedings provided that the



FIG. 4. NON-UNIFORM SEGREGATED SIZES OF BROKEN STONE IN WEARING COURSE OF BITUMINOUS MACADAM PAVEMENT. ONE-FOURTH ACTUAL SIZE.

mineral aggregate is of the general character heretofore mentioned in this paper under the section, "General, Non-Bituminous Highway Material."

The history of litigation cases indicates that the construction of bituminous concrete pavements of type B on a large scale will in all probability lead to litigation. The same remarks apply to the construction of bituminous concrete pavements of type C, except in the case of the so-called Topeka bituminous concrete pavement, with an aggregate of the type specified either in the 1910 Topeka decree or of the grading which was adopted at the 1915 convention of the American Society of Municipal Improvements.

*Type "A" Materials.*—Practice has demonstrated that broken stone, because of the satisfactory mechanical bond secured, makes the most suitable aggregate for this class of bituminous concrete, although pavements constructed with gravel have proved satisfactory for light traffic, where great care has been taken in the selection of the gravel and in the construction of the pavement. The development of the character of materials used in current practice has been covered in this paper under the title "General." Much more care has been taken in recent years with reference to the quantity of bituminous cement to be used in the mix. There has been a general recognition that the amount used depends upon the kind of road metal and the bituminous material, the character of the aggregate, and the climatic conditions. For the product of broken stone heretofore mentioned, it has been found that bituminous concrete mixtures should contain between 5 and 8 per cent by weight of bitumen.

*Mixing.*—Many improvements are noted in the methods employed in the mixing of bituminous concrete. There has been a general evolution from hand mixing methods to the utilization of mechanical mixers, especially designed for the manufacture of this type of bituminous concrete. The large contract for thirty-five miles of bituminous concrete pavement of this type around the Ashokan Reservoir, constructed under the direction of the Board of Water Supply of the City of New York, demonstrated the desirability of the manufacture of a plant especially designed for this class of work (see Fig. 8). The type



FIG. 5. SURFACE HEATER USED FOR DRYING OUT ISOLATED DAMP SECTIONS OF BROKEN STONE DURING THE CONSTRUCTION OF BITUMINOUS MACADAM PAVEMENT.



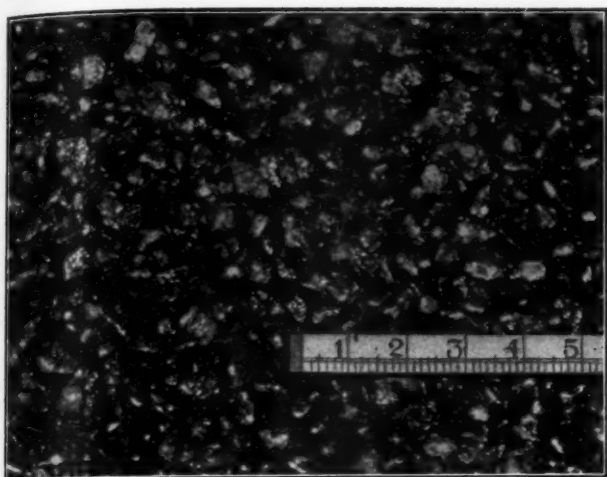


FIG. 6. COMPACTED WEARING COURSE OF BITUMINOUS CONCRETE PAVEMENT, TYPE A, PRIOR TO APPLICATION OF SEAL COAT.

finally evolved showed that it is practicable and economical to use a self-propelled plant, consisting of elevators, a rotary dryer, weighing devices, and a mixer, having a capacity of from 800 to 1,00 square yards of two-inch wearing course per day. Experience has demonstrated that, except on small contracts, and for repair work, mixers which provide for the heating of broken stone by the use of a flame in the chamber, should not be used on account of the danger of burning the broken stone or the bituminous concrete.

*Laying.*—There has been considerable discussion pertaining to the proper type and weight of roller to be used for the compaction of the wearing course. Experience demonstrates that in order to secure an even surface and adequate compaction by thorough interlocking of the particles of broken stone, a tandem roller weighing between ten and twelve tons should be used.

*Seal Coat.*—Many methods have been developed for the application of the seal coat of bituminous material. It has been found that seal coats of from one-half to one gallon per square yard of bituminous cement are distributed most uniformly by the use of hand-drawn gravity distributors (see Fig. 9), followed by a squeegee.

*Seasonal Limitations.*—Experience in many localities has demonstrated that bituminous concrete of this type should not be mixed or laid when the air temperature in the shade is below 50° F., as otherwise it is difficult, under average conditions, to secure an even and well-compacted wearing course.

*Type B.*—Specifications for this type of pavement have, during recent years, generally stipulated that so many parts of broken stone and so many parts of sand or other fine material are to be mixed with a certain amount of bituminous cement. By the use of this specification, unless employed under unusual supervision, it has been found to be impracticable to secure a well-graded aggregate. In many cases the mixture has contained an excess of broken stone with insufficient fine material to fill the voids therein, while in other cases it has contained an excess of sand in which the broken stone exists as isolated particles. It is the conclusion of many engineers, because of the conditions described, that when bituminous concrete pavements are to be

employed, either type A or type C should be selected.

*Type C.*—During recent years, the bituminous concrete pavements of this type which have been most extensively employed are known as Bitulithic, Warrenite, and Topeka.

*Bitulithic and Warrenite. Differentiation.*—The general use of Bitulithic and Warrenite bituminous concrete pavements throughout America has brought up for discussion the matter of the fundamental differences between these two types of patented pavements. It is believed that it will be of interest and value to the engineering profession to submit the following statement, prepared by George C. Warren, president, the Warren Brothers Company, for the information of the engineers enrolled in the graduate course in highway engineering at Columbia University:

Bitulithic and Warrenite mixtures are both made under the provisions of the Warren patents, which the courts have held "cover the product, no matter how produced." Bitulithic is designed to meet the conditions generally prevailing on city streets; and Warrenite is to meet such conditions as may arise on country roads, so as to meet the physical and economic conditions and public demands as to cost.

Generally speaking, Bitulithic is mixed by a plant which is too cumbersome to meet country road conditions, which provides for combining the materials proportioned by separation of sizes of the aggregate, after heating, and then recombining by weight.

Warrenite is, generally speaking, mixed by a plant so portable that it may be set up either alongside the railroad, along the side of the road being constructed, or in the quarry or gravel bank from which the bulk of the aggregate is being procured, as may be most economical in any particular case. This plant is constructed on the principle of proportioning the several separated sizes by careful measurement by bulk before heating and retaining the batch so measured as a separate entity through the process of heating and delivery into the mixer in which the bituminous cement is added.

Generally speaking, crushed stone predominates in the fine aggregate of Bitulithic, while sand predominates in the fine aggregate of Warrenite; also, fine crushed stone and sand respectively are correspondingly used for the seal coat aggregate.

In the selection of quality of material (whether gravel or crushed stone) for the course aggregate, a greater latitude is permitted in the case of Warrenite to practically meet the conditions of less opportunity for selections which are liable to prevail in localities considerable distance from railroad centers. This latitude is allowed, because, while the traffic conditions on country road thoroughfares are in point of weight and concentration of traffic rapidly becoming fully as severe as on most city streets, there is the important difference that on country roads generally the traffic is more exclusively of the motor-vehicle, rubber-tire type and consequently less exaction in physical properties of the quality of the stone forming the basis of the aggregate is necessary. Also, unfortunately, many city streets are abused by constant excessive sprinkling or daily scoured by pressure flushing machines, a practice which is



FIG. 7. BITUMINOUS CONCRETE PAVEMENT, TYPE A, HILLSIDE AVE., JAMAICA, N. Y., CONSTRUCTED 1911 (VIEW TAKEN 1916), SUBJECTED TO TRAFFIC OF 2,000 TO 5,000 VEHICLES PER DAY. NO REPAIRS HAVE BEEN NECESSARY 1911—1916.

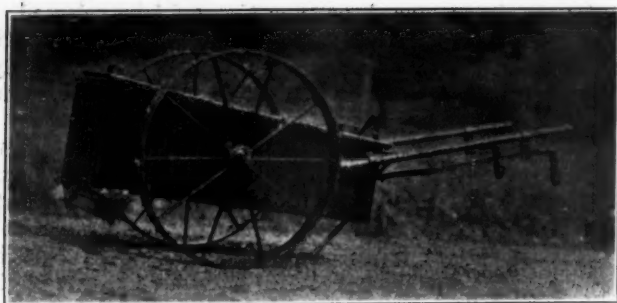


FIG. 9. TYPE OF DISTRIBUTOR USED IN APPLICATION OF SEAL COAT IN THE CONSTRUCTION OF THE BITUMINOUS CONCRETE PAVEMENT, TYPE A, AT ASHOKAN, N. Y.

more or less injurious to any road surface, while country roads are seldom, if ever, wet except by rainfall; therefore, in cases where the very best quality of stone is unavailable, it would be safe to use stone of slightly lower quality in Warrenite on a country road, although the same quality stone might not be safe for use in Bitulithic on a city street.

*Topeka.*—In many specifications the mineral aggregate for the Topeka pavement specified has been that contained in the decree of 1910, namely:

Bitumen, from 7 per cent to 11 per cent.

Mineral aggregate, passing 200-mesh screen, from 5 per cent to 11 per cent.

Mineral aggregate, passing 40-mesh screen, from 18 per cent to 30 per cent.

Mineral aggregate, passing 10-mesh screen, from 25 per cent to 55 per cent.

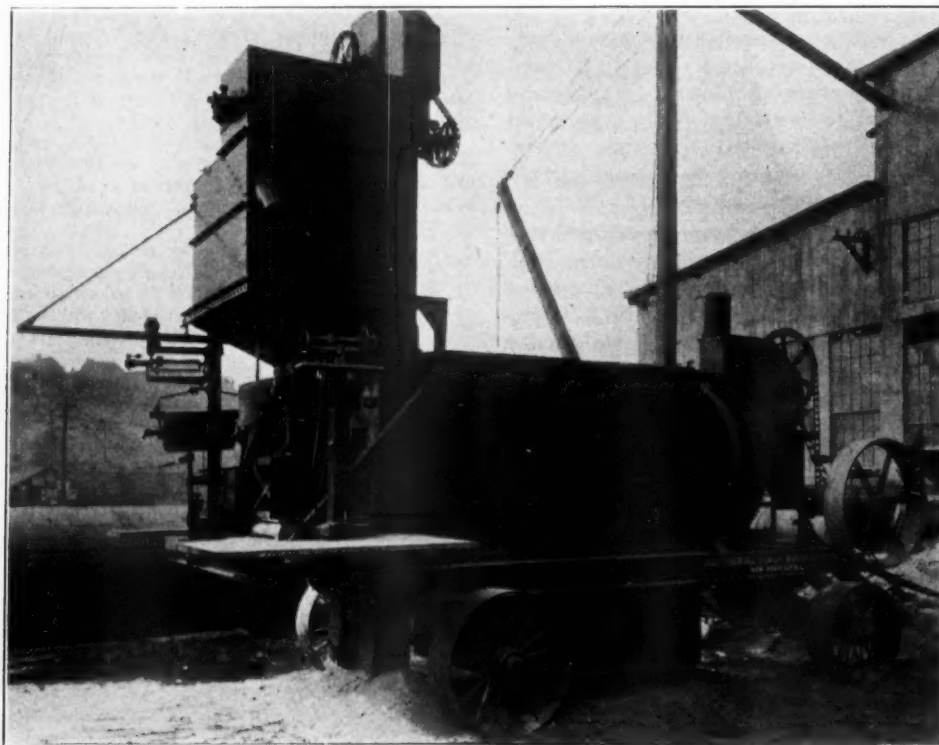


FIG. 8. TYPE OF MIXING PLANT USED IN MANUFACTURE OF BITUMINOUS CONCRETE FOR 35 MILES OF PAVEMENT AT ASHOKAN, N. Y.

Mineral aggregate, passing 4-mesh screen, from 8 per cent to 22 per cent.

Mineral aggregate, passing 2-mesh screen, less than 10 per cent.

Many unsatisfactory pavements have resulted by the unintelligent use of this grading. It has been found necessary, in order to secure successful results, to specifically define the character of the sand or other fine material which shall be employed in order to secure a satisfactory grading. Many specifications now cover the sand grading with almost the same care as in the case of sand

grading requirements for sheet asphalt pavements. In order to encourage the use of a more satisfactory grading for this type of pavement, the American Society of Municipal Improvements in 1915, recommended the adoption of the following grading:

Passing 200-mesh screen, 7 to 10 per cent.

Passing an 80-mesh screen, but retained on a 200-mesh screen, 10 to 20 per cent.

Passing a 40-mesh screen, but retained on an 80-mesh screen, 10 to 25 per cent.

Passing a 20-mesh screen, but retained on a 40-mesh screen, 10 to 25 per cent.

Passing an 8-mesh screen, but retained on a 20-mesh screen, 10 to 20 per cent.

Passing a 4-mesh screen, but retained on an 8-mesh screen, 15 to 20 per cent.

Passing a 2-mesh screen, but retained on a 4-mesh screen, 5 to 10 per cent.

*Causes of Failure.*—It should be noted that the percentage of failures of bituminous concrete pavements is much smaller than in the case of bituminous macadam pavements. Failures may be considered from the standpoint of the materials employed and methods of construction adopted. Failures have occurred because the type of pavement used was not suitable for the traffic or other local conditions.

Poor and unsuitable materials have been accountable for certain failures. In some cases an apparent cause of failure has been an excess of flux or of the volatile constituents in asphalt cements. Pavements constructed with such materials are frequently wavy, due to the movement of the surface under heavy traffic. Many of the

above causes of failure would be eliminated if engineers would devote more time to a consideration of the physical and chemical properties of the materials which they employ. If a bituminous material laboratory is not connected with the department, it should be neither expensive nor difficult to secure certified analyses made by reputable chemical engineers.

Either too large broken stone or stone of too uniform size may cause a failure. Especially is this the case with very hard and tough broken stone. The rocking of the

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stone causes the formation of fine cracks, which eventually lead to disintegration. Poor combinations of sizes of broken stone and sand have resulted in segregation during mixing, transportation, or spreading, resulting in a pavement of varying density and stability.

Many cases are reported where materials have been overheated, due to the belief that all materials may be and even should be heated to the same temperature before using, and that it is impossible to injure bituminous materials by heating to high temperatures. Overheating of the mineral aggregate has caused burning of the bituminous material in some instances or the formation of a thin film of bituminous material over the broken stone, which is not of sufficient amount to bind the adjacent stones together. The use of a wet aggregate will result in a poor mix with consequent unsatisfactory results. In many instances the seal coat has not been applied uniformly. The result is either uneconomical, due to the necessity of a second application before 75 per cent of the surface requires treatment, or the disintegration of the pavement whenever bare spots occur in pavements where coarse aggregate was used and where there is considerable horse-drawn vehicle traffic. Some failures have been caused by using with unheated stone bituminous cements which will not adhere satisfactorily or which mix only with great difficulty under such conditions. Many failures are due to poor foundations.

Careful consideration of the causes of failures will result in material benefit, inasmuch as a comprehensive knowledge of the various causes of failure is one of the most valuable assets of engineers having in charge the construction and maintenance of bituminous surfaces and bituminous pavements.

### SAND CLAY ROADS

**Excellent Road Where Traffic Is Not Too Heavy and Except During Protracted Wet Weather—  
Method of Construction.**

By JOHN McNEAL.\*

An automobile operator, who has been accustomed to operating his machine on sand-clay roads for a long period and is suddenly transferred to roads constructed of water-bound macadam or poorly constructed bituminous roads, will at once notice the superior qualities of the sand-clay in that, owing to the elasticity or resiliency of the sand-clay, the apparent shock to the automobile is much less than that caused by the macadam or poorly constructed bituminous road.

The writer has found the sand-clay road, even when badly rutted, superior to a macadam road; but it is, generally speaking, a dry weather road and a road best suited to a climate with a minimum amount of freezing weather. Long periods of rainy weather will seriously affect the best constructed sand-clay roads, but if the district in which the sand-clay road is constructed can afford to tolerate a bad condition of road for a few months during the year, it is the cheapest and one of the most satisfactory roads of which the writer has knowledge, providing it is properly maintained.

The materials found in South Carolina for sand-clay construction are practically ideal for the purpose. In some sections, these materials are found in proper proportions in the bank, while in other sections it is necessary to add more clay or more sand in proper proportions.

All classes of roads of proper construction require a well drained foundation, and the same requirements which obtain on other forms of road construction for a well drained foundation should also be applied to the sand-clay road. Ditches for carrying off the surface water should also be constructed on each side of the highway.

At locations where the sand and clay are not found in proper proportions, the clay may be hauled upon the roadway and carefully spread. The clay is then covered with a layer of sand, the amount of which has been regulated by judgment, or better still by chemical analysis, if an experienced road chemist is available.

The material placed as above should be mixed with a road harrow, the success of the road depending largely upon the thoroughness of this mixing and the proportioning of the sand and clay. Ordinarily a depth of six inches of compacted material is sufficient for most roads, and this depth may be slightly reduced where the foundation is in excellent condition.

The sand and clay having been properly harrowed, it should then be shaped with a road machine, the road lightly sprinkled, and rolled with a road roller.

The material will gradually harden under travel and may require occasional leveling with the road machine during the hardening.

Weak spots in the mixture will generally develop shortly after the road has been opened to public use. These should be immediately filled and rerolled if necessary. A split-log drag or road grading machine may be used to good advantage in removing the irregularities and in reshaping the surface after rains. Spots will occasionally develop which require a slight addition of sand or clay, and these should be attended to at once. Hard rains will have a tendency to bring the sand in the mixture to the surface, but rains of this nature seem to improve the roads by hardening the surface and are not injurious, unless the crown is so steep as to cause gullies to be washed in the surfac. Long continued rains of slight intensity have a tendency to soften the mixture, which allows the formation of ruts. These ruts should be repaired immediately, as deterioration is very rapid after a cut has once been made in the road-bed.

The writer has constructed many miles of sand-clay roads in the city of Columbia, S. C., under the supervision of a capable superintendent, L. H. Sligh, of that city, and R. C. Keenan, the council superintendent of the Street Department, both of whom have had long experience in the construction and maintenance of this class of roads. These roads have been fairly satisfactory on residence streets of ordinary travel, but they do not stand up well under heavy travel, especially in rainy weather. Wide streets of flat lateral grade, have been found difficult to maintain in a satisfactory manner and a narrow country road is better suited for this road material; both the original construction and maintenance being easier of accomplishment.

Road grading machines and scarifiers drawn by steam and gasoline traction engines have been used quite successfully in the work done by the city of Columbia.

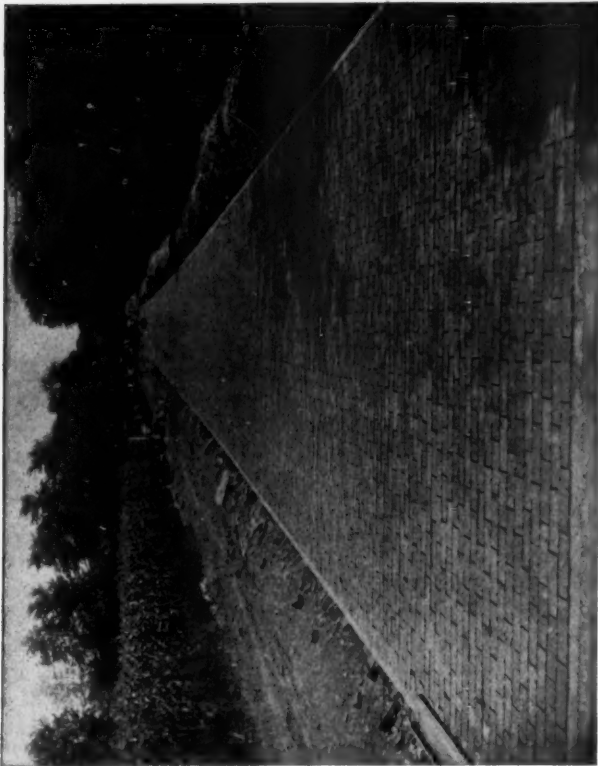
### CAUSES OF DEFECTIVE CONCRETE.

The following table is taken from a report by Deputy Commissioner H. E. Breed, on the progress of New York state highways, and refers to causes of low break as determined by tests made in the state's road testing laboratory of cubes made from concrete as being used in actual construction:

	Per Cent
Sand dirty, containing loam and also dirt from sub-grade .....	35.4
Stone or gravel coated .....	35.0
Sand too fine .....	8.5
Poor quality of stone or gravel.....	8.2
Poor manipulation in making cubes.....	4.7
Lack of proper mixing .....	3.5
Miscellaneous, too wet, etc.....	4.7

There were 1,444 cubes tested during 1915. This table gives the causes of low break in those cubes which broke below normal.

\*Consulting Engineer, Easton, Pa.

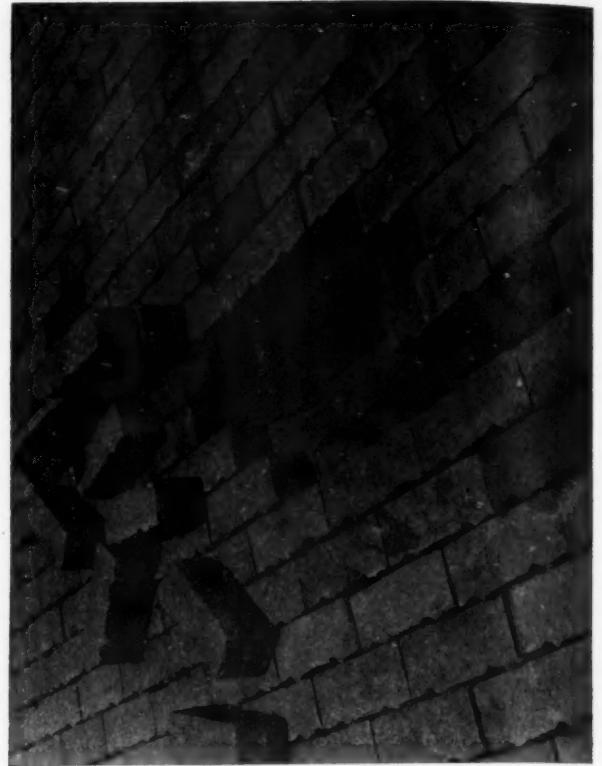
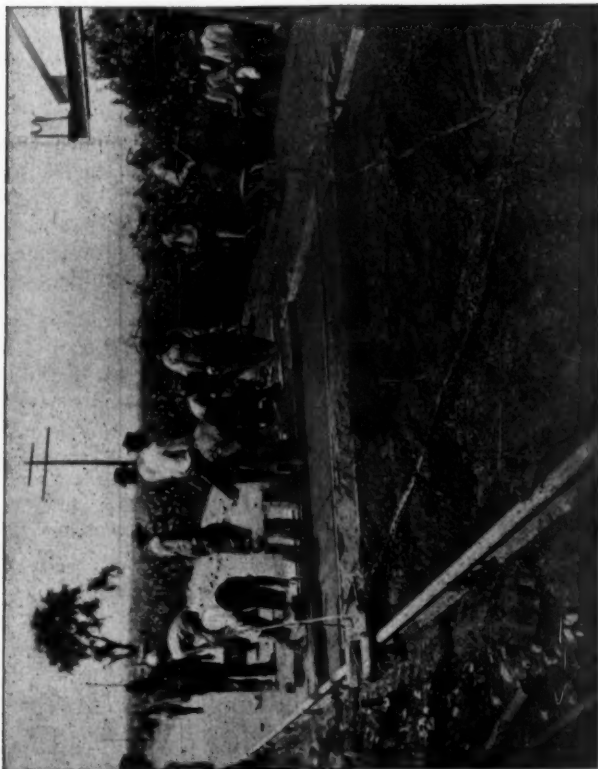


**Illustrating Recent Developments in Brick Pavements.**

The illustrations on this page show work on the Middle Springfield road, Paris, Ill.

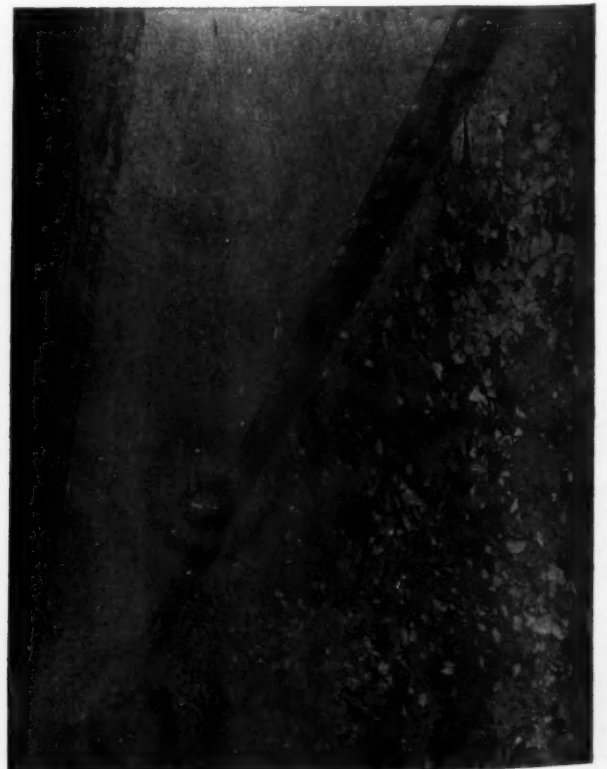
On the left is seen the template filled with the dry mixture of sand and cement, and the chain by which it is hauled over the concrete, the surface of which appears in the foreground. Brick is being laid immediately behind the template.

On the right is a photograph of one day's work, rolled but not yet grouted.



Of the two lower illustrations, the left hand one shows the road with the side forms removed. There is no curb, but the brick extend to the edge of the pavement, being held in place by the monolithic construction.

In the right-hand illustration nine bricks have been removed and the bed exposed, showing the complete bedding of each brick and the extent to which the mortar pushes up into the joint.





## RECENT DEVELOPMENTS IN BRICK PAVEMENT CONSTRUCTION

Laying on Green Concrete Foundation as Recommended by National Paving Brick Manufacturers' Association—  
Proper Mode of Construction by Double Template Described in Detail—Slap Board Method.

By MAURICE B. GREENOUGH.\*

The most noteworthy development in highway engineering construction during the past few seasons has been the method of laying brick pavements whereby the brick are placed in the green concrete foundation. That this method has merit is indicated by the rapidly increasing yardage which is constantly being reported. Its use has already extended to states, counties, and cities throughout the middle west, and as knowledge concerning it is disseminated, still more rapid growth may be expected.

The salient features of brick pavements built by this method are:

1. A solid combination of base and wearing surface.
2. The elimination of the hazard of a faultily prepared sand cushion.
3. Complete filling of the joints with bonding material.
4. Elimination of edging on country roads.
5. General economies effected by saving in materials, labor, and operations, combined with the promise of greater durability.

*New Specifications and Demonstration.*—To assist engineers, contractors and officials in familiarizing themselves with the new method, the National Paving Brick Manufacturers Association has recently issued specifications covering this type of construction, which they recommend as a method by which satisfactory results may be secured. They have also planned a physical demonstration of these specifications to take place at Paris, Illinois, on the 6th of October. A stretch of road will be chosen, and for an entire day the work will go on in accordance with these specifications, under the supervision of contractor Parish.

#### DOUBLE TEMPLATE CONSTRUCTION.

*Method of Construction.*—The method of construction which the Association recommends is one that has shown conclusively its feasibility, and the results secured justify its following specifications.

The preparation of the subgrade differs in no wise from that ordinarily required. A well drained uniformly compacted subsoil is just as essential for the success of this type of construction as for any other.

Following the preparation of the subgrade, steel side forms are placed, conforming to the line and grade of the finished pavement surface. The concrete is deposited from a batch mixer upon the subgrade between the forms. It is roughly struck off with shovels to a depth about an inch greater than the required finished depth. At the same time it is thoroughly spaded and joggled in order to compact the concrete, to compensate for any lack of uniformity in mixing, and to bring the mortar into contact with the side forms. Following this rough surfacing as a preliminary treatment, the base is struck off to the required finished depth by means of a double template resting upon the side forms and drawn forward by the mixer.

The type of template which has given the best service is one having two members, a six-inch I-beam at the front, and a six-inch channel or I-beam at the rear, spaced two feet on centers, rigidly framed so that the two members are parallel and provided with two rollers at either end to furnish the bearing and freedom of

movement upon the side forms. The cutting edge of the rear member is  $\frac{3}{16}$  of an inch higher than the cutting edge of the forward member. In the space between the two members of the template is placed a dry mixture of sand and cement of such proportions that its quality is equal to the quality of the mortar in the concrete base. A one to three mix has been found satisfactory, and it may be best prepared in a small batch mixer.

The forward movement of the template performs two operations simultaneously. It strikes off the concrete to the required depth and spreads upon its surface three-sixteenths of an inch of the dry mixture, which serves to fill any irregularities in the surface of the concrete which might be caused by scratching or dragging, leaving behind an absolutely smooth surface, upon which the brick are immediately placed.

Brick laying is performed from boards laid upon the surface of the brick already in position. The bricks are brought to the dropper on pallets or carriers, and so placed that in the natural operation of laying the brick the better edge will be uppermost and the lugs will face in the same direction. This special feature of laying the brick is one too frequently overlooked by contractors and engineers, sometimes being considered a detail of minor importance. Unless the better edge is uppermost when first laid, it becomes necessary to turn them over in the pavement, disturbing the base and causing unnecessary labor, both of which might have been avoided.

Immediately after the brick are laid they are inspected and at once rolled with a hand roller having a diameter of not less than 24 inches, a length of not more than 30 inches, weighing not more than 20 pounds per inch of length. This weight of roller has been found entirely adequate to produce a smooth surface, and the possibility of using a light roller is a considerable advantage and becomes a point in favor of this type.

Grouting the pavement is left until the close of each working period. In the case of a 10 or 12-foot roadway, by that time from 150 to 200 feet of pavement is usually completed. A vertical strip is placed across the roadway extending through the brick and concrete in order that the work may end in a vertical joint, and that there shall be no settlement near the joints due to leakage.

The method of grouting recommended in the specifications is that for which the Association has always stood, namely, the use of a grout box, having each of its legs of different length, from which the grout is removed and placed on the pavement in deep scoop shovels. This method has been recommended solely because experience has shown that its use is conducive to securing the highest quality of cement filler. It is a method wherein organization may be applied to good advantage, allowing just as rapid filling of the joints, but at the same time securing a better quality of grout than may be secured by other methods which are used.

In the recently issued specifications the Association has provided for the use of a machine mixer of the batch type. The character of the machine should be such that the surface of the pavement will not become splashed with oil or water, and that no other injury will occur to the surface through its operation. It is believed that the machine mixer will have its principal use in brick pavement construction in making the first application of

\*Instructor in Highway Engineering, Case School of Applied Science, and consulting engineer, National Paving Brick Manufacturers Association.

filler, and that subsequent applications may be made fully as economically and well by hand.

As many applications of the filler are required to be made as are necessary to completely fill the joints between the brick until they are flush with the surface of the pavement.

#### DISCUSSION OF METHOD.

The monolithic type of construction has its high points as well as other types. There are certain features which must receive careful attention in order to secure the best results.

*The Base.*—In the preparation of the base, it is quite necessary that the concrete as deposited be of uniform consistency; otherwise it becomes more difficult to secure the desirable smooth wearing surface. One of the advantages of this method of construction is found in the rough striking off and spading before the template is drawn over the concrete. This serves to compact the concrete, to settle the coarse aggregate thoroughly, and to compensate for any slight variation in consistency which may have appeared. These several operations can be performed very easily before the template is drawn forward. The amount of water used in mixing the concrete should be regulated to satisfy the following conditions:

First, that the concrete will be easily workable without being sloppy.

Second, that when finally struck off it shall be sufficiently stable to sustain the brick wearing surface without settlement in isolated places or being so soft as to allow the brick to be forced therein.

The thin film of dry sand and cement which is spread over the surface of the concrete with the forward movement of the template depends upon the water in the concrete to supply moisture for hardening and for forming the bond between the brick and the concrete base. There should be enough water in the concrete so that when the brick are placed and have stood for a few minutes, enough will have worked upward into the thin film to produce a plastic condition. There should never be so much, however, that water as such is particularly in evidence or in sufficient quantity to cause a separation of the sand and cement.

One of the advantages of using the dry mixture on the surface of the concrete is that it increases the stability of the concrete for brick laying.

The efficiency of the light hand roller for smoothing the surface of the brick after they are laid is a material advantage. Not only can it be used immediately in the rear of the droppers, but the danger of injuring the brick and the expense are both much less than when a tandem roller weighing from three to five tons is used.

*The Cement Grout Filler.*—In applying a cement grout filler two essential requirements must be satisfied: First, the condition of the brick in the joints must be favorable to the formation of a good bond extending the entire depth of the brick, second, the various operations of preparing and applying the filler must be such that the proportion between sand and cement as finally in place in the joints shall be the same as that specified.

The face of the brick in the joints are best prepared for reception of the filler by being lightly sprinkled with water immediately before placing the filler. Assuming that the brick were clean and free from any surface coating when they were laid, sufficient water is applied to them to insure a complete bond without any extraction of water from the filler, and without prohibiting the easy flow of the filler to the bottom of the joints.

The filler used in the first application must be mixed with enough water so that it will flow readily into the

joints, without any separation between the sand and cement.

Following the first application, a short period should elapse to allow it to settle but without hardening. The second application of the filler then follows, but for this a stiffer consistency is admissible because it is not necessary that this application flow to the bottom of the joints.

Presumably the first application has by this time settled in the joints a half inch or less, and provided the second application is properly squeegeed, there should be a complete union between the two; but as many more applications should be made as are necessary to fill the joints until they remain flush with the surface of the pavement.

In the monolithic construction, two applications have often been found sufficient; but the number of applications should not be definitely stated, but rather the requirements as to the flush filling of the joints.

#### THE SLAP BOARD METHOD OF CONSTRUCTION.

Still another method of securing this type of pavement is that wherein the concrete base is struck off by means of a single or double template, and the necessary mortar for bedding the brick is brought to the surface by means of a slap board similar to that used in the construction of concrete pavements.

When this method is used the concrete following the passage of the template is left in a roughened condition. In some places there will be mortar already on the surface. In others the coarse aggregate will be visible, and in some instances entirely devoid of any mortar. The slap board, producing a tamping motion, is applied with such force that the true surface of the concrete as struck off is destroyed, and whatever smoothness the surface may have after the slap board has been applied depends upon how well the concrete settles back into place. While to the eye this settling may seem to produce a perfect surface, it is a matter of chance as to whether this actually becomes the case.

#### COMPARISON OF METHODS.

The method which the Association has recommended in their specifications, and which they will demonstrate at Paris, Illinois, is a positive one. Every movement in construction is a forward movement. It is not necessary to go back over the work and disturb the concrete in any way after the template has passed over it. Whereas in the slap board method there practically always is the necessity of retouching the surface, of taking mortar from one place to supply a deficiency in another, and in general manipulating the surface of the concrete by means that are outside of the control of mechanical agency which insures as near as possible complete smoothness of the finished surface.

Various incidents might be described which bear out the writer's statement. In one case where the pavement was constructed by the slap board method, so much water was eventually brought to the surface that after the brick had been placed, inspection showed that there was a separation between the sand and cement, which would quite effectually prevent the formation of a perfect bond between the brick and the base. The bed in which the brick were placed was so fluid that they immediately came in contact with the coarse aggregate when laid, and sufficient "go and come" was not allowed for the slight surface adjustment necessary when they were subsequently rolled.

As far as the writer has observed, this condition has never developed with the use of the double template supplying a thin film of sand and cement. The thorough spading of the concrete, and the weight of the brick bearing down upon it has been found adequate to thoroughly amalgamate the thin coating of sand and



cement with the mortar in the concrete and, as has already been indicated, there is a positive control of all the factors which contribute to smoothness in the finished surface.

The method of construction which the Association recommends in their specifications is one susceptible of systematic organization on the part of the contractor's

forces. The work progresses steadily and smoothly, and there are none of the harassing delays and small patch work operations which prove so expensive in the long run. That method of construction which secures the best results with the greatest economy, and at the same time simplicity in operation, in the long run proves the best in road construction.

## EASTON-BETHLEHEM CONCRETE HIGHWAY

Effort by State Highway Commission to Construct Model Road Twelve Miles Long—Tests to Determine Most Effective Mix and Time of Mixing—Measuring Expansion, Contraction and Vertical Movement.

By JOHN McNEAL,\* M. Am., Soc. C. E.

The concrete highway now being constructed by the Pennsylvania Highway Commission under the direction of William D. Uhler, chief engineer of the commission, is unique in some ways and a model for excellent work and painstaking construction, and has therefore attracted more than ordinary attention of highway engineers and others interested in road construction. Construction was started in July, 1915, and is now nearing completion. The road is the main thoroughfare between Easton and Bethlehem, Pennsylvania, a distance of about 12 miles, and it is intended to eventually extend it to Allentown, six miles further. The lines of the original public road were generally followed in the construction of the new concrete highway, but changes in curvature and grade were made where deemed advisable.

The paved portion of the highway is 16 feet wide, and this is backed up on each side with a berm or shoulder 4 feet wide, making the total width 24 feet. The berm has a slightly steeper slope than the concrete-paved portion. Tile drains have been laid under the berm on each side of the road where the alignment runs through a cut, and at other points where the draining of the sub-soil was found necessary. These drains are constructed of terra-cotta porous tile 4 inches in diameter, laid on a grooved board in the ditch under the berm, the board being 2 feet below the sub-grade of the concrete pavement. The tiles are without bell and spigot, laid close together and tar paper placed over each joint. After being laid, the tile drains were covered with crushed stone, composed principally of tailings from the stone-crushing plant, which were filled in to the top of grade and covered with earth taken from the road excavations.

Drain pipes crossing beneath the highway were placed

at necessary points, to which the 4-inch tiles were connected, and the drainage carried by this means to convenient outlets. The cross drains ranged in size from 12 to 30 inches in diameter, as necessity required. The cross drains up to 12 inches in diameter were made of corrugated galvanized iron pipes, and the larger sizes of cast iron pipe.

In connection with the galvanized iron pipes, it might be of interest to note, that the pipes for the entire length of the ditch are connected before lowering into place, and then are easily rolled into the ditch upon completion of the excavation; a method which facilitates the work and assures accurate alignment and grade.

Line stakes, which are used to give the grade also, are set at offset distances from the center of the highway, and used throughout the construction for both the tile drains and finished road.

The roadway was excavated for a width of 16 feet, and the sub-grade well sprinkled and rolled with a ten-ton road roller. Upon completion of the rolling, 6-inch steel channel forms in 12-foot lengths were placed along the outer edge of each side of the driveway and held in place by means of iron pins driven into the ground.

The concrete paving mixture was composed of 3 bags (or 3 cubic feet) of Portland cement, 6 cubic feet of clean, sharp sand, and 9 cubic feet of crushed limestone of the size known as one-inch stone. The stone and sand were placed in piles along the finished sub-grade, ahead of the paving, and delivered to the mixer in wheelbarrows holding 3 cubic feet each, insuring accurate quantities for each batch.

The concrete was mixed, medium wet, in the Koehring circular mixing machine, holding the above described batch, and revolved one and one-half minutes in the drum. The mixer was placed on runners laid along the sub-grade ahead of the work and propelled by its own power. A projecting arm, with sliding bucket, placed the concrete at the desired location.

The road was constructed with a level sub-grade, the concrete paving having a thickness of 8 inches at the center and 6 inches at the sides, making the center crown of the finished paving 2 inches.

The concrete laid during 1915 was placed for a depth of 4 inches, immediately after which Kahn expanded metal of 5x12 inch mesh and about No. 10 gauge was placed thereon, and the balance of the concrete mixture to the above described crown was at once placed. The placing of



DELIVERING AGGREGATE TO CONCRETE MIXER.

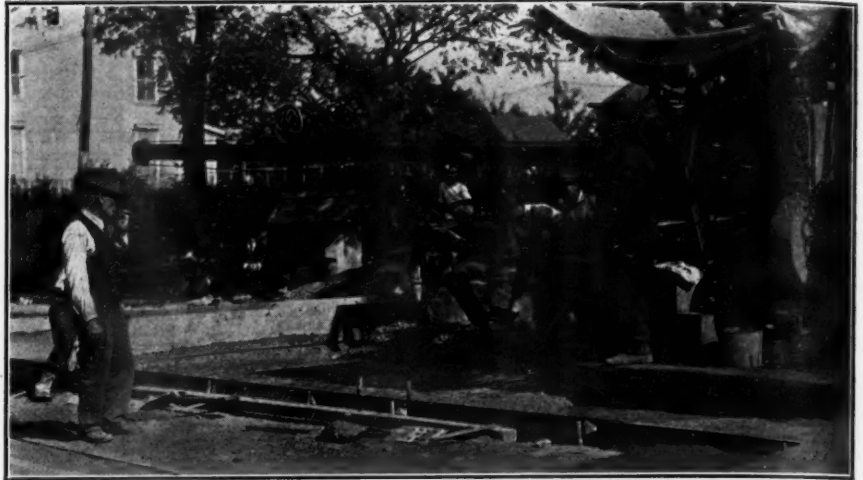
Wheelbarrows are run on subgrade to mixer, which also rests on subgrade. Sand and stone are brought to the work over the trolley track, which is just outside the picture at the left. A canvas cement shed, not in use, is seen at the right leaning against the fence.

\*Consulting Engineer, Easton, Pa.

the expanded metal has been somewhat changed in the work done during the present year. The concrete this year has been laid parallel with and 2 inches below the finished crown before the expanded metal was placed, and afterward completed in the regular way to the proper crown.

The entire roadway is consequently made at one time. Templets cut to the proper crown and resting on the steel forms on each side of the road are drawn by hand over the concrete to give the surface its initial finish. Two templates are used, a heavy one being used first to strike off the surface, followed by a lighter one to give a better finish. Each can be used by two men, but the heavy one alone seemed to leave a wavy surface. The surface is then floated by means of a wood float. In order to allow the finishers to properly float the surface and prevent walking on the concrete, a bridge, about 12 inches in width and supported on the steel forms along the side of the road, was used. The sides of the pavement along the steel forms, and at the lateral expansion joints, were smoothed with an edging tool.

Expansion joints were originally placed 39 feet 6 inches apart, but most of them have been placed 40 feet apart. The joints for the greater part of the entire twelve miles have been made of elastite or asphalt strips. Steel armor joints were placed on one section of about 1,000 feet in length. The elastite joints are placed 9 inches deep for the entire width of roadway pavement, extending to subgrade and supported in place during construction by steel plates properly braced. The thickness of the joint is one-half inch. After the steel plate is removed the pro-



MIXING AND PLACING THE CONCRETE.

The bottom layer has been placed and the reinforcement on top of it, and the top two inches are being laid.

jecting elastite is trimmed to within one-half inch of the finished pavement.

Upon completion of the work and during cold as well as hot weather, the concrete is protected by means of canvas covers elevated about twelve inches above the roadway, and each section, after it has hardened, is covered with from two to three inches of dirt and kept wet for ten days; and the dirt covering is allowed to remain fourteen days before removal, after which the road is opened to travel.

The broken stone used in the work has been crushed in a plant located in about the center of the twelve miles of roadway, and delivered by means of auto trucks or the street railway, which parallels the highway. The sand is brought by railroad from New Jersey and delivered in the same manner.

One-inch crushed stone only is used in the concrete, the tailings being used, as previously stated, in the drain-



GENERAL VIEW OF CONSTRUCTION ON EASTON-BETHLEHEM TURNPIKE.

Men using heavy templet. Expansion joint material extending above pavement in foreground. Empty canvas cement shed at left of mixer, full one behind telegraph post.



age ditches, and the screenings for road repairs at other points.

Small sheds, with wood frames and canvas covers, were placed along the road at about 30-foot intervals for storing the cement. These sheds were about 12 feet long and 3 feet wide, and held 90 sacks each.

The average length of road laid per day has been about seven sections, or 280 feet. None of the concrete paving was laid after November 15, 1915, on account of cold weather, and the work during the present year was started early in May.



STRIKING OFF CONCRETE WITH TEMPLET AND FLOATING SURFACE FROM BRIDGE.

In connection with this work, studies have been made of the effect upon concrete of varying the time of mixing and the proportion of the ingredients, and these studies are being continued. The times in the revolving mixer have been one minute, one and a half, two, two and a half, and three minutes. The variation has been in the aggregates only, there always being 5 parts of these to 1 of cement, but the ratio between sand and stone was varied, as  $1\frac{1}{2}$  parts sand to  $3\frac{1}{2}$  parts stone, etc. In the actual construction, however, the mix of 1:2:3 has been adhered to, and revolved in the drum for  $1\frac{1}{2}$  minutes. Experiments made at the outset by 8-day compression tests on cubes gave the following results:  $\frac{1}{2}$  minute mix, 1,400 lbs. sq. in.; 1 minute, 1,587 lbs.;  $1\frac{1}{2}$  minutes, 1,624 lbs.; 2 minutes, 1,661 lbs.; 3 minutes, 1,673. The increase for the 2-minute and 3-minute mix was not considered worth the additional time and cost.

Tests have been and are being made on contraction and expansion of the pavement. For this purpose steel pins one inch square were set in the concrete roadway extending from top to bottom of the concrete. These pins were set in slabs at both top and bottom of some of the grades and in the level slabs just adjoining the grade sections. The pins were centered and accurately referenced in every direction with steel tape and transit so that any movement in any direction may readily be detected to the one-hundredth of a foot. Measurements are being taken at varying temperatures and will be continued throughout the year, winter and summer. To determine whether there is any heaving or settlement of any part of the pavement, especially with relation to their connection with longitudinal cracks, lines of precise levels have been run taking elevations at the end of each slab, at each corner and in the middle.

(We hope to publish results and conclusions from all these tests in a few weeks. W. D. Uhler, chief engineer of the State Highway Department, informs us that the information is not yet "in such condition as to warrant our drawing any definite conclusions as to the work."—Editor.)

There has been a slight heaving at some of the joints during very hot weather this summer, but they after-

ward settled to their original position, without apparent injury to the concrete.

The entire work to date is in practically perfect condition. Two of the 40-foot sections alone show slight longitudinal cracks, which are said to be due to the concrete becoming anchored to the rock foundation, which prevented the expansion joints from performing their proper function.

At the present writing the road is an ideal one, and its future wearing qualities will undoubtedly prove that the success of concrete roads depends very largely upon



STRETCH OF COMPLETED CONCRETE ROAD.

the attention to details in construction and expert workmanship. Credit is due the Pennsylvania State Highway Department, and especially the chief engineer, for the painstaking methods adopted for this work. The writer is indebted to Geo. E. Carr, foreman, for information given from which this article has been prepared.

#### PAVEMENTS ON CLAY SOIL.

A description of extensive cracking of pavements laid on clay soil in Wichita, Kan., was given by P. L. Brockway in our September 14th issue; and an editorial reference to the matter, suggesting certain lines of inquiry and investigation which might help to offer an explanation of the cracking and a solution of the difficulty, which is experienced in a number of cities. In the letter below Mr. Brockway answers some of the questions asked in this editorial.

September 27, 1916.

Editor Municipal Journal:—

Dear Sir:—

Your editorial comment and questions raised concerning the cracking of pavements on clay soil are very timely. Some of the questions I can readily answer in so far as our local conditions govern.

First:—All of the pavements having concrete bases are so nearly water tight, even if not absolutely so, that moisture enough to saturate the clay subsoil could not filter through them. The rain falling on adjacent lawns and gardens is absorbed by the soil, sinking down to more impervious layers of gypsum and following along on top of them. The gypsum occurs at varying depths, from outcrops on side hills to a depth greater than encountered in ordinary wells (50 to 60 feet deep) or probably not at all, so far as surface conditions are affected. The capillarity of the soil constantly brings moisture to the surface under the pavements, as well as outside, from the percolating water beneath. It occurs to me, as I write, that the variation in size and number of cracks which has been observed may be governed by the depth of the impervious stratum beneath.

Second:—The concrete does not crack the first season after laying, but only in seasons of unusually light rainfall and heavy evaporation. The first cracks observed were in a pavement two or three years old and some of these cracks were further widened this year under a sound sheet asphalt surface during an excessively hot, dry period following an unusually wet period of over a year's duration.

Third:—With these facts in mind, it would not help any

to wait for the maximum contraction of the clay; in fact, we could not do that, because of the irregular occurrence of conditions causing maximum contraction; nor would using the concrete base for a season and sealing the cracks help any for the same reasons.

Fourth:—If unrestrained by outside structures, the clay tends to crack into small cubical masses from a few inches to two or three feet in size with only occasionally large cracks which have been traced to a depth of twenty feet in excavating open trenches. This shrinkage, as suggested, could not crack a concrete base at one place without a corresponding compression in another or a lateral movement of part of the surface. This explains why the cracks are longitudinal and not transverse. The diagonal crack mentioned in the former article was observed at an intersection where the street changed to a new line by nearly the width of itself.

Measurements show that this lateral movement actually occurs, the wedging action against the lower surface of the crowned pavement shoving the detached strips out against the slight resistance of the shrinking soil in the parking space. When the soil swells again under increasing mois-

ture content it is plastic and flows under the pavement back to its original volume.

The only reasonable explanation for the fact that the comparatively light wire mesh reinforcement prevents the cracking is that, while concrete is weak in tension, it is very nearly strong enough to break the bond between the concrete and the subsoil and requires only a small amount of assistance to accomplish this end.

It is not believed that the sand cushion will run into the cracks enough to endanger the surface of the pavements because, as explained above, the unrestrained cracks are close together and small, and occasional large cracks are very irregular in width and alignment.

It is doubtful if the cracks could be prevented by rolling in coarse sand or gravel because they are so deep and the cause lies deep in the soil. The cracking of the pavement would be prevented by this method.

The most troublesome question with us here is how to make a reasonably permanent repair in concrete pavements and a reasonably cheap repair in grout filled brick pavements.

P. L. BROCKWAY,  
Asst. City Engineer.

## BITUMINOUS WEARING SURFACES FOR OLD MACADAM

Mixing and Laying Amiesite in Connecticut and New York—Resurfacing a Boston Street with Bitulithic, and New Jersey Roads with Warrenite and National Pavement—Bitoslag in Pennsylvania.

In Massachusetts, Connecticut, New York, New Jersey and Pennsylvania, and to a less extent in most of the other eastern states, a considerable part of the more pressing work on the highways consists of reconstructing macadam roads which have been worn out by a traffic for which macadam is no longer suitable. In some cases the old metal is entirely removed, but much of the recent work consists of using it as a base for a new wearing surface. We present below descriptions of how this is being done with each of the more commonly used bituminous pavements.

### MIXING AND LAYING AMIESITE.

Though great neither in cost nor in magnitude of the work, the resurfacing of 18,000 square yards of worn out macadam near New Rochelle, N. Y., has several interesting features. Amiesite, which is being used for the new wearing coat, is being laid on an old macadam surface, which is scarified, re-shaped and rolled thoroughly in preparation for the new construction. Shaping and grading were done by pick and shovel, a crown of about  $\frac{3}{8}$  of an inch per foot being used and the top of the road being brought to a grade about 2 inches lower than the surface of the finished pavement. It was necessary to remove some of the old stone in order to keep the grade to the proper level and this was stored to be used later in constructing shoulders.

The Amiesite, which is an asphaltic concrete so treated that it may be laid cold or even stored for a long period before laying, is manufactured at a permanent plant of the Amies Road Company located at Plainville, Conn., nearly 100 miles from New Rochelle, and is shipped in steel gondola cars to that city.

In the manufacture of the material a very fine grained and closely knit trap rock is used. This is secured from the Connecticut Trap Rock Company, which has a plant but a few hundred feet from that of the Amies Road Company at Plainville. The quarry at this plant is one of the largest in the state and has a capacity of 2500 tons per day. Stone, blasted out from the quarry, is loaded into steel cars of 7-ton capacity, which run on 42-in. gauge tracks. These tracks lead from all parts of the quarry to the crusher and are laid at such a grade that they will coast slowly to the crusher when loaded, but must be pushed back by hand. From the crusher the stone is carried in elevators to storage bins. Such of

it as is required for manufacturing Amiesite is taken by cart or motor truck—usually the former on account of the short haul—and dumped into sunken bins. Ordinary dump carts or rear dump trucks are used.

Elevators carry the materials to the top of the plant, where they are discharged into weighing bins. Oil, stored in a large tank near the plant, is kept in constant circulation by a steam pump and at the same time maintained at a temperature of about 260 deg. F. by steam heat, the use of which removes all danger of overheating or burning. Naphtha for dehydrating the stone is stored nearby and is pumped as needed by a small steam driven pump. The boiler is located in an outhouse some distance away and no heat, save that from the steam, is allowed near the main plant.

Amiesite is mixed in batches of about 2250 pounds, about 1850 pounds of stone being required. On this stone is sprinkled or poured naphtha in the amount required by the condition of the stone and depending upon the amount of contained moisture. From 5 to 7 per cent by weight of asphaltic cement, at a temperature of about 260 deg. F., is then poured on and the whole thoroughly mixed by mechanical methods similar to those in use in the ordinary bituminous concrete plant. To this, when well mixed, is added the screenings, and lime, the mixing process continuing until this is thoroughly incorporated. It is then dumped into cars for shipment to distant points or into motor trucks for shorter hauls. Car tracks run directly under the mixers so that these may be discharged directly into the cars.

Following are the Pennsylvania State Highway Specifications for Amiesite materials and mixing:

**ASPHALT:** The asphalt used in this type of pavement shall conform to the following specifications: Specific gravity not less than 1.00; solubility in carbon bisulphide not less than 99%; penetration at 77 degrees F. (100 grams, 5 seconds, Dow method), not greater than 175 and not less than 125, and after heating 5 hours at 325 degrees F., a fifty-gram sample shall show a penetration of 77 degrees F. (100 grams, 5 seconds, Dow method), not less than 50% of the original penetration; the ductility at 50 penetration shall be not less than 50 centimeters.

**MINERAL AGGREGATE:** Mineral aggregate for the bottom course shall be clean, crushed rock of approved quality run of crusher passing a 2-inch ring and being retained on a one-quarter inch screen, free from foreign materials. The French co-efficient of wear shall be not less than twelve. Mineral aggregate for the top course shall be





QUARRY AT PLAINVILLE FROM WHICH STONE FOR AMIESITE IS OBTAINED.

similar, except that all of it shall pass a  $\frac{3}{8}$ -inch screen and be retained on a one-quarter inch screen.

**FILLER:** The filler shall be clean crushed rock screenings of approved quality, all passing a one-quarter inch screen.

**MIXING:** The mineral aggregate shall be treated with a liquifier to make the asphalt adhere. The asphalt, heated to approximately 275 degrees F., then shall be added and after the mineral aggregate is coated thoroughly, ground oxide or hydrate of lime shall be added. The ingredients referred to above shall be mixed in the following proportions:

	Bottom Course.	Top Course.
Mineral Aggregate.....	86 to 90 per cent	86 to 90 per cent
Filler .....	4 to 6 " "	5 to 8 " "
Asphalt .....	5 to 6 " "	5 to 7 " "
Lime .....	$\frac{1}{2}$ to 1 " "	$\frac{1}{2}$ to 1 " "
Liquifier .....	$\frac{1}{2}$ to 1 " "	$\frac{1}{2}$ to 1 " "

In rainy weather, excess moisture on the stone is evaporated by steam heat in a small drum located near the main plant. The stone is then treated in the usual manner or it may be mixed in a small special plant near the drying drum.

At New Rochelle, the Amiesite is unloaded by skips into motor trucks and hauled about two miles through the main part of the city. In unloading, three skips are used, each holding about  $\frac{3}{4}$  of a ton. These are fastened to the car sides and two men assigned to each, one with a 20-pound iron bar for loosening and breaking up the

Amiesite, compacted by the long trip, and the other with a fork. Each Autocar truck carries about  $2\frac{1}{4}$  tons—the capacity of the three skips—and make the 4-mile trip (2 miles each way) in 20 to 25 minutes. Six men thus unload  $2\frac{1}{4}$  tons in 20 to 25 minutes, or at the rate of about 6 tons per hour. The time required to load the trucks, if the skips are full, is about  $1\frac{1}{2}$  or 2 minutes, while the time necessary for unloading does not usually exceed 1 minute. The average number of trips per day for each truck is 20, some time being lost in negotiating the heavy traffic through the central part of the city, and the usual amount carried per day is 45 tons for each of the two trucks.

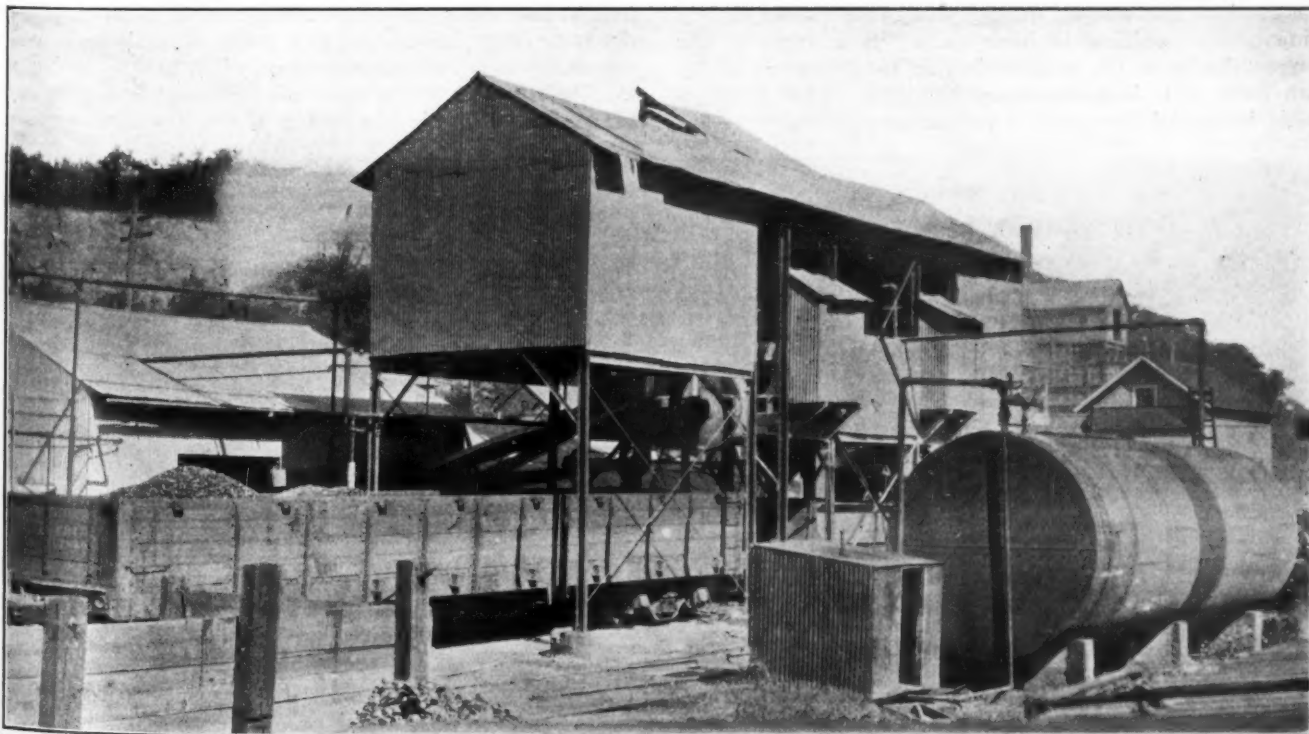
The trucks are charged at the rate of \$6 per day for depreciation, and maintenance and the expense for oil, gas and chauffeur totals \$7.58 per day, making the total



EMPTYING CAR OF AMIESITE INTO TRUCK BY MEANS OF SKIP.

cost \$13.58 for hauling 45 tons 2 miles. This is equivalent to 15.1c. per ton-mile, or 30.2c. per ton of haul. Adding to this a cost of about  $31\frac{1}{4}$ c. per ton for unloading—the men on this work are paid \$2.50 or \$2.75 per day—the total cost for handling and hauling, exclusive of freight, is  $63\frac{1}{2}$ c. per ton.

The trucks are equipped with a rear dumping device



MIXING PLANT AT PLAINVILLE, CONN. AMIESITE DISCHARGED DIRECTLY INTO GONDOLA CARS. Quarry is seen in background. Stone crusher is between quarry and mixer.

and the Amiesite is dumped directly on the compacted macadam base, previously swept clean, or on a board platform. Owing to the method of dumping, which does not cause the material to fall in a compact mass, but slides it from the rear end of the truck, there is no



SPREADING SURFACE MATERIAL BY TRUCK.

danger in dumping directly on the sub-grade. In addition, all the material is handled over and all lumps are broken up with forks or rakes.

The first course is laid about 3 inches thick and is rolled with a 7½-ton Kelly-Springfield tandem roller. A 1-inch layer of top course material, composed of ¾-inch and smaller stone, is spread for a filling and wearing coat, and this is rolled thoroughly, starting at the sides and working toward the center. Following the application of a light coat of clean, sharp sand, the road is thrown open to traffic.

The same plant is furnishing material for a somewhat smaller job in Waterbury, Conn. This consists of paving between street car tracks on an old macadam base. It was necessary to use considerable new stone in preparing the foundation on this work, the whole being rolled thoroughly with a 10-ton roller to form a firm base. Amiesite for this job is shipped in the same manner as for the New Rochelle work, but in unloading, owing to lack of space in the yards, somewhat different methods had to be adopted. With a short haul, wagons were used exclusively and the men loaded directly from the car into the wagon, though this caused some loss of time due to waiting in line. Also, on account of the longer throw to the wagon, it was necessary to assign two men with forks to every bar-man. This arrangement increased the cost of unloading slightly.

Street car traffic had to be maintained on both tracks and the Amiesite was therefore dumped on platforms along the tracks and distributed by wheelbarrow as needed, the distance usually not being greater than 30 feet. Spreading and placing was done as described above. To keep the Amiesite from sticking, the dumping board and the tools were kept well oiled.

In tamping the material close in and against the web of the rails, a special type of pick was used. These had one prong cut off about 3 or 4 inches from the point and a bar about 1 inch square and 4 or 5 inches long welded on at right angles to the handle. With this tool work was more rapid than with the ordinary tamping bar usually employed.

A 10-ton roller was employed for compacting the surfacing, but much of the rolling had to be done on boards, especially while close to the rails. The top coat was applied in the manner employed on the New Rochelle job.

The Charles T. Eastburn Co. is the general contractor for both jobs, the former being under the charge of William Halton and the latter under Wayne Robison, both division managers for the contractors.

#### BITULITHIC AND WARRENITE.

Commonwealth avenue, Boston, has recently been paved by placing a bitulithic surface on an old macadam base. A section of this avenue, 1.3 miles long, which was so treated this season, extends from Arlington street, to Beacon street, is under the jurisdiction of the Department of Parks and Recreation, and is probably the most well known and modern residential arterial boulevard in New England, being the beginning of Commonwealth avenue boulevard, which extends through Boston, Brookline and Newton to the Charles river at Weston, a total distance of 11 miles. The section improved contains two drives, each 35 feet wide, and a parkway in the center, 100 feet wide, shaded by four rows of old elm trees with a number of historic statues in the center.

The macadam surface in this roadway has been maintained at heavy expense for about 20 years, this maintenance including the spreading of bituminous materials at intervals; but automobile traffic has so increased the wear that during the five years from 1908 to 1913, the maintenance cost an average of 18 cents per square yard per year. (The cost of 1914 and 1915 are not available.) Early in the spring of this year the majority



REGULATING OLD MACADAM TO GRADE, USING POINTS IN STEAM ROLLER AND ROAD GRADING MACHINE, COMMONWEALTH AVE., NEAR FAIRFIELD.





LAYING BITULITHIC ON COMMONWEALTH AVENUE.

of the property owners petitioned to have the roadway reconstructed with bitulithic over the old macadam, the owners agreeing to reimburse the city for the 25 cents per square yard additional cost of this pavement over the price bid for bituminous pavement of another class. The contract price for the work was  $8\frac{1}{2}$  cents per square yard for scarifying and regulating the old grade, and \$1.53 per square yard for the bitulithic surface, including a 5-year guarantee.

In preparing the street for resurfacing, it was first loosened up with picks or points inserted in the steam roller wheels, and the loosened material was then brought to a uniform surface by a road scraper, which knocked off the high spots and spread the material into the low ones, loosening the old macadam as little as possible. Following this, the macadam was rolled thoroughly until perfectly solid, and the bitulithic surface was then applied and rolled in the ordinary way. It is seen by the above that the cost of the base so prepared was only  $8\frac{1}{2}$  cents per square yard in place of the 80 cents to \$1, which it would have cost to put in a concrete base, and it is believed that the results will be fully as satisfactory. Considerable work of this kind has been done in and around Boston. Sections of two streets, Dartmouth and Berkeley streets, were resurfaced in this way as far back as 1903.

#### WARRENITE IN MIDDLESEX COUNTY.

Middlesex County, New Jersey, assisted by state aid, is improving a sixteen-mile stretch of highway leading from New Brunswick to the county line and known as the Cranberry turnpike, by surfacing with Warrenite, the old macadam being used as a base for the greater part of the work. This was a macadam road throughout, which was in fair condition over most of its length, except for wear which made resurfacing desirable. The trying conditions of last winter and spring, however, had developed some soft spots where the road had become uneven, possibly totaling a mile in length, and here the macadam is being removed and a 6-inch concrete base substituted. Concrete is used in a few other short stretches also, as where the grade is lowered to remove a hump, or a curve is flattened by slight change in the line; also at two or three points where new masonry

culverts have been built and the road and sub-soil necessarily removed.

Except at these points where concrete is used, the old macadam is scarified, new stone spread, the road shaped up, and rolled to form a solid base. The old macadam is about 12 to 14 feet wide. The new road is to consist of 18 feet of Warrenite, a 2-foot macadam strip on each side of this, and 4 feet of dirt shoulder extending to a drainage ditch on each side. This requires adding two or three feet of base on each side of the old macadam, and this is done by excavating for this and placing  $2\frac{1}{2}$ -inch stone here before any other work is done. This stone is covered with earth for a binder and rolled, and the traffic and hauling of material help to compact it.

When the old macadam has been scarified,  $1\frac{1}{2}$ -inch stone is spread over the entire width of 18 feet and shaped up so as to bring the road to proper grade and give a 3-inch crown. This is rolled thoroughly, then screenings are spread and it is rolled again; following which  $\frac{1}{4}$ -inch stone is rolled in, which gives a surface permitting better adhesion of the top coat than would otherwise be the



OLD MACADAM REGULATED TO GRADE AND ROLLED (EXCEPT IN FOREGROUND), COMMONWEALTH AVENUE, NEAR FAIRFIELD.

case. The road is supposed to be rolled as solid as a new macadam, so as to furnish a firm base for the bituminous top.

The construction of the base is let in four sections to different local contractors, and they are employing somewhat different methods for carrying on the work. T. H. Riddle, of New Brunswick, who has the section nearest the city, places and rolls the  $2\frac{1}{2}$ -inch stone on the shoulders for widening the base, then scarifies the old surface, hauls on the  $1\frac{1}{2}$ -inch stone and dumps it in the middle of the road and spreads it by hand ready for rolling.

Mr. Erickson, who has a section near the other end of the improvement, after placing and rolling the  $2\frac{1}{2}$ -inch



SCRAPER USED IN SPREADING STONE OVER SCARIFIED MACADAM. STONE PARTLY SURFACED.

stone on the shoulders, dumps the 1½-inch stone in a continuous pile along each edge of the macadam, and then, after the teaming is done, scarifies the old macadam and then spreads the stone from the sides onto the road by means of a road scraper. The remaining operation of rolling the macadam is the same in each case.

This addition of new stone and shaping and rolling of the same is paid for by the cubic yard of stone supplied. Trap rock is being used for this base, as it can be obtained for only about 10 cents per cubic yard more than limestone, and the additional toughness probably makes it worth the difference, even though it is not exposed to wear.

It is desirable that care be taken to give this macadam base a surface uniformly parallel to that required for the finished wearing surface, in order that the latter may have a uniform thickness throughout. Non-uniformity in thickness would almost certainly result in non-uniformity in density, spots where the top surface was thickest being least solidly compacted and such spots probably would not hold their surface, but would develop unevenness under wear.

As fast as the macadam base is completed, it is being covered with a Warrenite surface and the road thrown open to traffic. This surface is made 2 inches thick and, as stated, 18 feet wide. It is mixed in a plant located along the river in New Brunswick and about two miles from



DRUMS HEATING AGGREGATE FOR WARRENITE.  
Elevator leading to screens at the left. Cans of asphalt in foreground.

the beginning of the improvement. The "hot stuff" is hauled from here by motor truck, is dumped onto a platform of 2-inch planks which is spread upon the prepared macadam base, and shoveled from this platform to its final position. Before placing the top surface material, 2-inch x 4-inch wooden strips are laid 18 feet apart to form a curb, and are held in place by long spikes driven into the road. The raking and rolling of this are performed in the same way as similar operations in connection with sheet asphalt or other pavements of its general nature. The men are provided with shoes having wooden soles about an inch thick, to protect their feet from the heat of the asphalt. The pavement is rolled with a 10-ton roller until solid.

Immediately after the completion of this rolling a flush coat is applied by a squeegee box (a contrivance consisting of a small metal box on two wheels and provided with a rubber squeegee; a hole in the bottom of the box permitting the hot liquid asphalt to flow onto the pavement and the squeegee spreading the same). About 1-6 of a gallon of flush coat is applied per square yard of pavement. This is immediately covered with either grit or coarse sand, about one cubic yard of this being used for each 200 square yards of pavement. After

the spreading of this material the road is again rolled with a 12-ton roller, and is then ready for traffic.

The aggregate used in the surface material consists of trap rock stone, passing a 1¼-inch screen down to ¾-inch, of screenings between ¾-inch and 200-mesh, and sand. These are heated in two drums into which the aggregate is lifted by bucket elevators, and after being heated to a temperature of 250 degrees the combined aggregate is carried by a bucket elevator to the top of the plant structure, where it passes through rotary screens, where the entire material is re-divided into the desired grades of fine, medium and coarse material, each of which is dropped into a separate bin. By means of vertical chutes provided with horizontal shear gates, the material can be dropped from each bin separately into the weigh-bucket. The material from each bin is weighed separately by means of a 6-multiple weigh beam, and the whole is then discharged into the mixer immediately beneath. The finest material and the asphalt are mixed first for a few seconds and the coarser material is then discharged and the mixing continued. Each batch contains 1,500 pounds of aggregate and 110 pounds of asphalt. The mixing is continued for about a minute and a half and then, by pulling a lever, the batch is discharged into a motor truck which is standing immediately beneath. Eight batches constitute a load for a truck.

The asphalt used has a penetration of about 105 or 106. It is heated in one of four tanks, which are used in succession, the entire drum or can containing the asphalt being thrown into the tank after having been pretty well broken up with axes. Wood fires are used under the asphalt tanks, and about 12 to 18 hours consumed in bringing the asphalt to the desired temperature. In the morning, before beginning operations for the day, the tin from the drums is pulled out of the tanks. With asphalt of this penetration, and especially in warm weather, it is impracticable to strip the tin from the asphalt before placing it in the tank. The asphalt has a temperature of about 300 degrees when placed in the mixer, and the mixture reaches the trucks with a temperature of about 250 degrees and loses not more than 5 to 10 degrees in the two-mile haul. The plant is at present turning out sufficient hot stuff for 1,400 to 1,500 square yards of 2-inch top per day.

Once an hour a sample is taken of each of the several grades of aggregate used, and these are analyzed. Also each day a sample of the mixture as it leaves the plant and one of the asphalt used are sent to the Boston office. The analyses of all these are recorded and kept on file for future reference, the exact section of road laid with each day's mixing also being recorded.

Three 5-ton and 6-ton Mack and Garford trucks are used. It is believed by the superintendent that for a haul over two miles they are cheaper than horse-drawn wagons, but under about two miles the horses would probably be cheaper. Material has been hauled as far as 35 miles from this plant, which is considered to be about the limit for trucks. The inside of the truck bodies are whitewashed at intervals to prevent the asphaltic material sticking to them. It requires about 15 minutes for each truck to back into position and receive the eight batches which constitute a load, and about 30 minutes to haul 2 miles to 2½ miles, dump and return. The three trucks are thus able to handle the output of the plant at present, but a fourth will be put on in a few days, when the construction has progressed further from the plant and the haul becomes longer.

The above information was furnished to the writer by A. E. Stone, superintendent for Middlesex county of the Standard Bitulithic Company, which is doing the surfacing work.



### NATIONAL PAVEMENT IN NEW JERSEY.

There is being constructed in Millburn Township, New Jersey, on Springfield avenue, a heavily traveled thoroughfare leading from Newark, a bituminous pavement composed of a mixture of asphalt and mineral matter which is differentiated from ordinary sheet asphalt or bituminous macadam by entire absence of any but the very finest particles. The material mixed with the asphalt consists of a natural soil of which about 80 to 85 per cent is clay and 15 to 20 per cent is very fine sand. The average of analyses made hourly for several weeks gives from 50 to 64 per cent of the total mineral aggregate passing through a 200-mesh screen and only 3 to 5 per cent retained on a 30-mesh screen, while only a small fraction of 1 per cent would be retained on a 10-mesh screen.

This clay (the percentage of sand is so small and it is so extremely fine that the material as a whole has a clayey nature) is brought by rail from a point about five miles distant from the road to a railroad siding about a

cylinder in this condition and at this temperature, the greater part of it being finer than the ordinary Portland cement.

In the meantime the asphalt (in this case Mexican asphalt is being used) has been heated to approximately 300 degrees and the two are discharged into an Iroquois mixer. The specifications require that the amount of asphalt used shall be between 15 and 20 per cent of the product. The amount has been varied slightly between these limits and the contractor has fixed upon 17 per cent as apparently giving the best results. (The amount of asphalt necessary to obtain such result will apparently vary with the fineness and possibly certain other characteristics of the clay employed as the mineral aggregate.) At the beginning of the contract asphalt with a penetration of 90 was used, but this has been increased to 110 penetration.

After being thoroughly mixed, the hot stuff is discharged directly into horse-drawn dump wagons, the temperature now being between 230 and 260 degrees. As stated before, the haul to the highway is about a

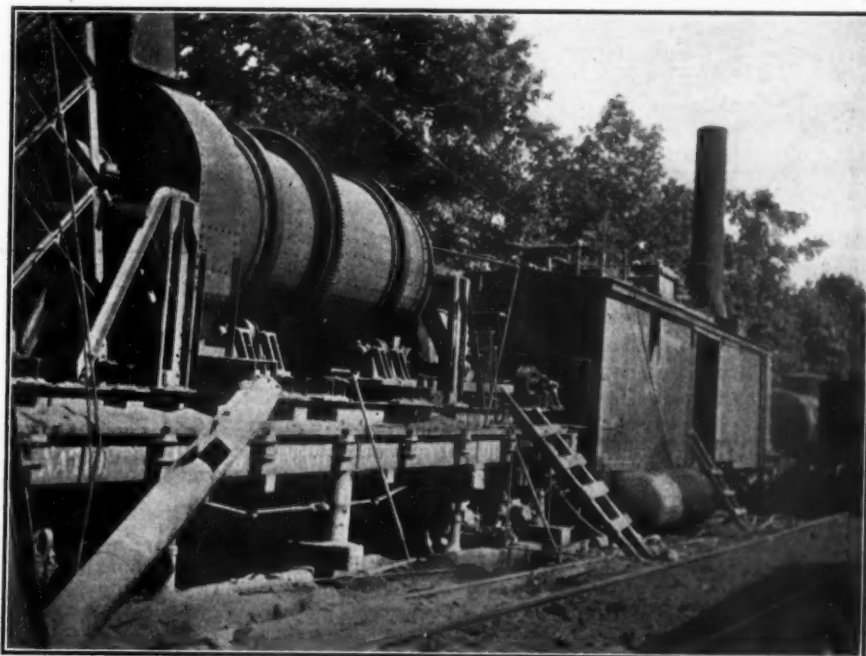
#### PULVERIZER AND BOILER HOUSE, MILLBURN PAVING.

This is a semi-portable railroad plant.

The boiler is in the background.

In the foreground is the pulverizer.

In the lower left-hand corner is the pipe leading the pulverized material to the foot of the bucket elevator which discharges it into the mixer.



half mile from the center of the stretch of highway under construction. Here the clay is dumped in a pile at the foot of a bucket elevator which runs continuously and discharges the clay into a heating and drying drum.

The drying drum in some respects resembles the rotary kiln of a Portland cement plant, except that it is only about 10 feet long. The flame from a fuel oil burner is blown into this cylinder at the upper end, at which end the clay also is introduced by the buckets. Inside of this cylinder is a pulverizer—a small cylinder traveling at about 600 revolutions per minute, on the outer surface of which are a number of rows of narrow flanges or teeth. The inside of the outer cylinder carries a number of flanges or blades extending longitudinally through the cylinder. The teeth on the inner cylinder are arranged spirally in such a way as to work the clay from the upper to the lower end. The high velocity of the inner cylinder throws the clay against the outer and the flanges on the latter raise it and drop it again onto the inner cylinder; the flame from the oil burner meantime raising the temperature to about 300 degrees. The combined effect of the heat and the impact against the outer cylinder results in breaking up the clay into its ultimate fine particles and it leaves the

half-mile long, and the job being about one mile long, the total haul varies from a half mile to one mile. The material is said to hold its heat appreciably longer than ordinary sheet asphalt mixture and there is very little loss of temperature during transportation.

The pavement being laid consists of 24 feet width of this bituminous material, on each side of which there is laid an 18-inch strip of bituminous macadam constructed by the penetration method. The whole is laid on the old telford macadam road as a base; the thickness of the telford base and macadam surface averaging about 17 inches. The surface is scarified, re-formed with a fairly high crown, and re-rolled to form a base for the new surface.

The new asphalt surface is applied in two thicknesses, the first giving 1 inch thickness after rolling and the second 1½ inches after rolling. In compacting the material, a 3-ton roller is first used until it ceases to yield appreciably under this, and a further compacting is then effected by the use of a 6-ton roller. Buffalo steam rollers are used. The top surface is given a thin coating of portland cement, as is frequently done with sheet asphalt, but no sand or other coarse aggregate is used at any time. It apparently is necessary to roll this material about twice as long as is the practice with

sheet asphalt before the pavement is satisfactorily hard. Before placing the paving mixture, a plank curb is placed along each side of the road the required distance (24 feet) apart and fastened in place by long iron spikes driven into the ground; these curbs being left in place until the rolling has been completed. Following after the rolling (not necessarily immediately after, several days sometimes intervening), the curb is removed and 18 inches of stone is spread and rolled on each side and treated with asphalt heated in a small road kettle to provide the penetration macadam shoulders.

The work comprises a total of 12,900 sq. yds. and is being performed by the Franklin Contracting Company for the County of Essex; the state also having the road in charge, since it is a state aid contract. Both state and county retain inspectors on the work, in addition to which there is a third inspector to watch the preparation and other treatment of the asphalt mixture, this inspector representing Dow & Smith, who are retained by the county as consulting engineers and chemists. The work is in charge of W. A. Strother of the Franklin Contracting Company. Fred A. Reimer, engineer of Essex County, is engineer in charge of the work and is giving it careful attention in order that good results may be obtained from this, the first pavement of this kind to be laid in this section of the country. Several thousand yards have, however, been laid in Iola, Kansas City, Kan., and Pittsburgh, Kansas, Independence, Mo., and other cities.

Nearly a half mile of the pavement has been thrown open to use and has now seen several weeks of service. The pavement has compacted slightly under traffic and presents a little harder surface than when first opened to traffic. A knife blade can be pushed into the new pavement as into a piece of rubber, although it is not soft enough to receive more than a faint impression from the caulks of the horses' shoes; but that which has been used a few weeks seems to be as hard in this respect as the regular sheet asphalt pavement.

#### IRON FURNACE SLAG FOR ROADS.

The chief by-product of the manufacture of iron in blast furnaces is slag. An enormous quantity is produced; for every hundred tons of iron made in such a furnace, from forty to sixty tons of slag are also made. It accumulates in great piles and its utilization is not only a convenience to the iron-makers, by removing otherwise waste material requiring storage space, but is also a desirable act of conservation of our resources. It is a hard, dense, tough material, which railway companies have crushed and used for many years in ballasting their tracks. For a quarter of a century it has also been used in road-building, but until quite recently very little was ever said of this work. Road-builders near slag piles tried the material, found it satisfactory and continued to use it. But they said little or nothing about their experience, and as the stranger driving over a road built of crushed slag cannot see anything different about the surface from the appearance of a road built of crushed stone, having the same general properties, very little was done to arouse an interest in the material.

Finally comprehensive road improvement projects were undertaken in some states and a brisk demand for good crushed stone developed. Only a small proportion of our native rocks are really suitable for roadbuilding, however, and thus a quite wide interest developed rapidly in slag as a road material. It has been in service now on a large scale for several years in Ohio, Pennsylvania, and New York, and to a smaller extent in West Virginia, Illinois, Michigan, New Jersey, Delaware, Maryland, Alabama, Georgia and Mississippi. The experience with it has

not been so long as with different classes of rocks, but it has been so satisfactory that the material is recognized in the specifications of some of the leading state highway departments. Furthermore, the U. S. Office of Public Roads built an experimental road of slag at Youngstown seven years ago and the reports of the annual official inspections of the road, made since it was laid, are convincing testimony of the value of this by-product that has so long been regarded as of very limited utility.

A pavement using slag in combination with asphaltic cement is coming into use under the name of "Bitoslag." An experimental stretch laid in McKeesport, Pa., is said to show practically no signs of wear, holes, cracks, or disintegration after five years of service. This pavement was laid last year on a street in Germantown, Philadelphia, which carries a heavy traffic of heavy loads on iron-tired vehicles, horse-drawn. A contract for the same pavement in Allegheny County, Pa., is now nearing completion. This pavement is laid as a wearing surface two inches thick on old macadam or other pavements, or on concrete. Or a base of water-bound slag concrete may be used.

The specifications of this wearing surface call for a bituminous binder (called "Bitoslag cement") with the following qualities:

Specific gravity at 77° F. .... Not less than 1.03  
Flash point, open cup. .... Not less than 450° F.  
Soluble in carbon di-sulphide. .... Not less than 99.5%  
Penetration at 20° F. (200 gram weight 6 seconds),

Not under 15  
Penetration at 77° F. (100 gram weight 5 seconds) .... 25-35  
Penetration at 115° F. (50 gram weight 5 seconds),

Not over 90  
Ductability at 77° F. .... 5-10 cms.  
Sulphur, not added before, during or subsequent to refining, not less than .... 3%

The slag used is hard air-cooled blast furnace slag crushed so that all particles will pass a one-fourth inch screen. The proportion of dust or filler to be added depends upon the proportion of finely crushed slag, the complete mineral aggregate conforming to the following mesh composition:

Passing 200 mesh sieve. .... At least 15%  
Passing 100 mesh sieve. .... At least 25%  
Passing ¼ mesh sieve and retained by 20 mesh sieve,

At least 45%  
Retained on ¼ mesh sieve. .... None

The asphaltic oil used shall comply with the following requirements:

Character at 77° F. .... Fluid  
Flash point, open cup. .... Over 350° F.  
Loss, 5 hours at 325° F. .... Not over 5%  
Character of residue. .... Fluid

Any asphalt plant which is capable of mixing sheet asphalt or asphaltic concrete pavement can be utilized for mixing this surface material.

#### ROAD AND BRIDGE EXPENDITURES IN 1916.

Statistics for the calendar year 1915 recently compiled by the Office of Public Roads and Rural Engineering of the U. S. Department of Agriculture, show that the total length of public roads in the United States outside the limits of incorporated towns and cities was about 2,452,000 miles on January 1, 1916. Of this, about 277,000 miles, or 11.3 per cent, were improved with some form of surfacing. The mileage of surfaced roads has been increasing at the rate of about 16,000 miles a year, and in 1915 approximately one-half of this increase was made under the supervision of State highway departments. In addition, these departments supervised the maintenance of nearly 52,000 miles of main and trunk line roads.

The increase in expenditures for road and bridge work in the United States has been approximately \$80,000,000 per



year in 1904 to about \$282,000,000 in 1915, an increase of more than 250 per cent. The expenditure of state funds during this same period increased from about \$2,550,000 to more than \$53,000,000. In addition, more than \$27,000,000 of local funds was spent under state supervision in 1915, bringing the total road and bridge expenditures managed by the states to \$80,514,699. This amount is greater than the total expenditures for roads and bridges from all sources in 1904.

The growth in importance of the state highway departments has been rapid. The first of these agencies was created in 1891 in New Jersey, and now some form of highway department exists in every state except Indiana, South Carolina, and Texas. These departments had expended since their inception to January 1, 1916, an aggregate of \$265,350,825 in state funds for road and bridge construction, maintenance, and administration. They had constructed over 50,000 miles of roads in cooperation with the states. More than 40,000 miles of these roads were surfaced.

The falling off in the value of road work performed by statute and convict labor was from \$20,000,000 in 1904 when the total road expenditures were \$80,000,000, to about \$15,000,000 in 1915 when the total expenditures had grown to \$282,000,000. This was a reduction from 25 per cent of the total in the former year to less than 5½ per cent of the total in 1915.

The cash road and bridge expenditures of the United States averaged only \$28 per mile of rural roads in 1904. In 1915 this average had grown to \$109 per mile. New Jersey led all other states both in 1904 and in 1915 with \$221 and \$475 per mile respectively. Nevada made the least expenditure in both years—\$3.72 per mile in 1904 and \$17 per mile in 1915.

### STONE BLOCK FOR COUNTRY HIGHWAYS.

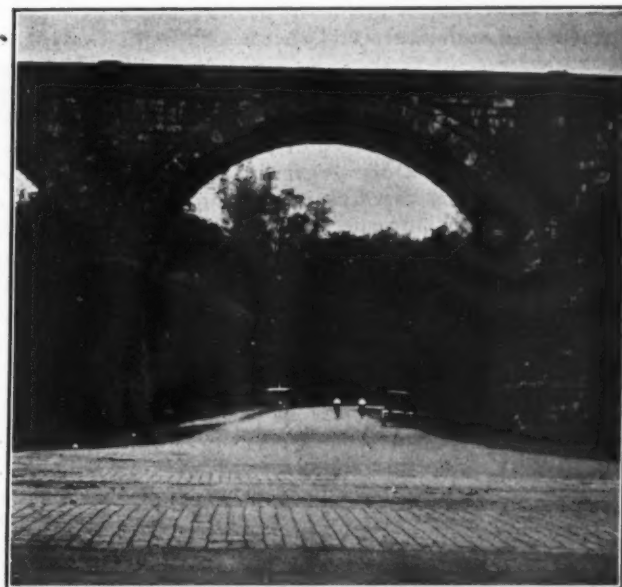
Stone block has generally been considered as especially adapted to the intense and heavy traffic of large cities or points of concentrated freight hauling, but during the past two or three years its use has been extended to highways outside of city limits. One illustration of this is on a Massachusetts state highway near Spencer, Mass., where granite block with a depth of 4 inches, was laid on a rather steep grade and the joints raked to give better foothold, similar to the use of side-hill brick. Another illustration is found on the Paterson-Hamburg Turnpike, which is described in the article following this by county engineer Garwood Ferguson.

Another illustration, which, while it is within the city limits, is still on a road having more the nature of a county highway, is found at the intersection of the main drive through Fairmount Park, Philadelphia, and Ridge avenue. A concrete foundation already existed at this point, and engineer William H. Connell decided to lay granite block pavement at this point, with the narrow joints provided by the improved specifications, but use a block only 3½ to 4 inches deep. These blocks were made 3½ to 4 inches wide and 7 to 10 inches long; and this pattern of pavement, slightly modified to 3¾ to 4¼ inches wide and 7 to 11 inches long, has been adopted by the Granite Paving Block Manufacturers Association as a resurfacing block for use in cases where another kind of pavement upon a concrete foundation is to be replaced with granite.

These block were laid on a 1-inch sand cushion and the joints were filled with a 1:1 grout mixture. The blocks were supplied by Booth Bros. and Hurricane Isle Granite Company, and were laid by Jos. J. McHugh of Philadelphia. This intersection was laid in January of this year during a spell of open weather, and as soon as grouted the pavement was covered with sand and earth

to protect it from freezing as much as possible. This protection apparently met the requirements, for the pavement is at present in excellent condition, although some of the grout on the surface has not stood the heavy traffic as well as it might have had the work been done in more favorable weather. This intersection carries traffic of more than 2,000 vehicles per day, both light automobiles, heavy auto trucks and steel-tired horse-drawn trucks, carrying heavy loads to a paper mill. The trucks carry from 4 to 6 tons.

These three examples illustrate two conditions under which stone block seems to offer advantages—very heavy hauling and steep grades; the demands of one being met by the durability of the pavement under wear, the other by the gritty surface of the blocks.



RIDGE AVENUE AND PARK DRIVE, PHILADELPHIA.

There are several advantages in the shallow blocks, the chief one being that of cost. There is a greater or less amount of stone in the quarry, which could not be made up into blocks of standard size, but can be made into 4-inch blocks with very good results. The cost of making the small blocks would be about the same as that of the large, but as the material now finds little demand the quarries are, at present at least, willing to furnish them at less cost. In addition to this, the freight per block is of course less, and the handling and laying of the blocks can be done at somewhat less cost.

### GRANITE BLOCK ON A COUNTY ROAD

Used on a Five Per Cent Grade on a New Jersey Highway—Shallow Blocks with Grout Filler on a Four-Inch Base.

By GARWOOD FERGUSON.\*

The improvement of the Paterson-Hamburg turnpike was commenced by the Board of Chosen Freeholders of Passaic county, New Jersey, during the early part of the season of 1915. This road, which by the way is one of the finest scenic roads we have in northern New Jersey, runs from Paterson through and over the Preakness mountains to Pompton Lakes and so on to Newfoundland to the Sussex county line, a distance of about 23 miles. Only on that portion of the highway between Paterson and Pompton Lakes, a distance of about seven miles, has the work of improvement been commenced. The contracts were given out in four sections, the main

\*County engineer of Passaic County, New Jersey.

object being to expedite the construction, which was for the greater portion of a rather heavy type.

The mountainous character of the county which this highway traverses necessarily meant many steep grades on the old route and with a number of sharp and dangerous curves, but it was decided to limit the maximum grade on the new construction to 5 per cent, with a maximum of 6 degrees for the curves.

For the greater portion of the improvement, bituminous concrete on a 5-inch broken stone base was the type of pavement decided on, with the exception of about three-quarters of a mile of reinforced concrete roadway. On the grades of 5 per cent, however, because this kind of construction is of a too slippery nature for horse-drawn traffic, it was decided to use a small-sized granite block laid on a 4-inch concrete base. On part of this heavy grade construction, stretches of granite block pavement fourteen feet wide were laid in the center of the roadway, with a macadam shoulder eight feet wide on either side; and on the remaining portion, a center strip of bituminous concrete fourteen feet wide was laid, with shoulders of granite block eight feet wide on either side.

The quality and texture of granite required was similar to that required by the Granite Paving Block Manufacturing Association for specification block. The granite blocks were laid on a 4-inch concrete base (the concrete being 1-3-6 mixture) with a 1½-inch cushion coat of sand. The blocks were of the following dimensions: 6 to 12 inches long, 3½ to 4½ inches wide, and 4 to 4½ inches deep. They were dressed so as to be smooth, with no projections varying more than ⅜ of an inch from a true plane, and so formed as to lay ½-inch joints.

After laying the blocks, pea stone was sprinkled over same in a quantity just sufficient to hold the blocks in position but not enough to prevent the grout from flowing. The blocks were then rammed until a true and even surface was formed, rolling being deemed unnecessary.

The grouting was prepared from one part of Portland

cement to one part of clean, sharp sand, mixed with enough water so that the grout would run freely and fill up every void between the blocks. After standing a few minutes, a second application of the grout was applied, this being somewhat thicker than the first mixture and so placed that the joint would be completely filled to the top of the block. The grout was allowed to set almost an hour and then sprinkled with water and broomed to an even surface, no surplus grout being left on the top of the block. A light sprinkling of sand was left on the block and traffic kept off same for ten days.

The small granite block can be laid for about \$3.00 per square yard, which is considerably cheaper than the regular specification block. The actual cost of laying the block complete, without contractor's profit, on this particular job was as follows; all on a square yard basis:

Block .....	\$1.85
Cartage .....	.17
Sand .....	.03
Spreading sand .....	.01
Pea stone and grout.....	.21
Laying .....	.13
Concrete base .....	.38

Total .....\$2.78 per sq. yd.

On main highways in outlying districts, the use of granite blocks on the steep grades is not only economical from a stand point of life of pavement, but gives a foot hold for horse-drawn vehicles under all weather conditions which no other type of pavement will produce. The improvements made in granite block pavement in the last few years are such that a smooth surface can be attained which is in every way suitable for horse and automobile traffic.

While the initial cost is higher than that of almost all other kinds of pavement, its life will outlast them by many years, as granite blocks are able to stand all of the abuse which the modern auto trucks may put upon it.

On a portion of this highway, for a distance of three-quarters of a mile, a reinforced concrete pavement 20 feet wide and 6½ to 8 inches in thickness, with 2-foot macadam shoulders, was constructed and is standing up to the heavy traffic splendidly.

The pavement is monolithic in character and is composed of 1-2-3 mixture, the stone being of such a size as to pass a 2-inch ring and be retained on a ¼-inch opening.

The reinforcing was placed about 2 inches from the surface, the metal fabric having a cross sectional area of .038 parallel and .049 perpendicular to the center line of pavement respectively. The surface was struck off with a templet and finished with a wood float leaving a rough but level surface.

Asphaltic expansion joints one-quarter inch in thickness and of a depth almost one inch wider than the thickness of the pavement were used at intervals of 35 feet. The cost of this pavement, not including excavation, was \$1.35 per square yard.

The bituminous concrete which forms the surface of the greater portion of the improvement is of the Amiesite and Topeka types, the contract price being \$1.12 and \$1.01 per square yard, respectively, which, with the 5-inch stone base, made a total cost without excavation of about \$1.50 per square yard.

The entire improvement when finished will cost almost \$200,000 for a distance of almost seven miles, which is approximately \$30,000 per mile. This cost, however, includes the grading, culverts, drains, retaining walls, and everything necessary to bring the roadway up to the highest form of standard construction.



SHALLOW GRANITE BLOCKS ON PASSAIC COUNTY ROAD. Broom marks can be seen in the grout in the middle of the picture, although the pavement has been in use for a year.



# Municipal Journal

Published Weekly at  
50 Union Square (Fourth Ave. and 17th St.), New York  
by  
Municipal Journal and Engineer, Inc.

S. W. HUME, President  
J. T. MORRIS, Treas. and Mgr. A. PRESCOTT FOLWELL, Sec'y

A. PRESCOTT FOLWELL, Editor  
W. A. HARDENBERGH and SIMON BARR, Assistant Editors

Telephone, 2805 Stuyvesant, New York  
Western Office, Monadnock Block, Chicago

## Subscription Rates.

United States and possessions, Mexico and Cuba.....\$3.00 per year  
All other countries ..... 4.00 per year  
Entered as second-class matter, January 3, 1906, at the Post Office at  
New York, N. Y., under the Act of Congress of March 3, 1879.

## Change of Address.

Subscribers are requested to notify us of changes of address, giving both old and new addresses.

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*Contributions suitable for this paper, either in the form of special articles or as letters discussing municipal matters, are invited and paid for.*

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## OLD MACADAM FOR FOUNDATIONS.

In sections of the country, in the eastern states especially, where there are hundreds of miles of old macadam which is getting into pretty bad surface condition, it has become quite a common practice to use this as a base for a new surface material, sometimes brick but more commonly one of the bituminous mixtures. The wisdom of this in many cases is unquestionable, but in other cases the foolishness of it is equally unquestionable and the result painfully evident.

Where use during several years has both compacted the macadam and the sub-base and also demonstrated that the drainage (either natural or artificial) is ample, there would seem to be little if any advantage in removing the old macadam and substituting a concrete base, *provided* there is enough of the macadam left and in such condition that it will uphold the weight of any trucks which the new surface will attract to the road. There is also the objection in the case of city streets that in repaving over trenches which may be opened in the future there will be more danger of settlement of the patches than if a concrete base were used; although we see no reason why, in such cases, the base for the repaving should not be made of concrete even though the base on the balance of the street is macadam.

The advantage of using the old macadam is largely a financial one—the saving of 70 to 90 cents a square yard for the concrete plus the cost of removing the old macadam, and minus the cost of scarifying, reshaping and rolling the macadam used for base, if this is necessary. To throw away this very considerable sum would be foolish if the old macadam and its sub-base are satisfactory for use.

Unfortunately, such satisfactoriness is sometimes taken for granted or the necessity for it entirely overlooked. Last winter and spring were unusually severe on inadequate foundations in the eastern states, and there

are in the vicinity of New York City (especially in the clay soil region of New Jersey, we believe) many miles of good bituminous surfaces which have gone all to pieces because of the failure of the macadam base on which they were laid or of the poor drainage of the soil foundation. The latter is especially in evidence this year. Stretches of road can be found where, within a mile stretch of a single resurfacing job, can be found alternating stretches of excellent pavement and almost impassable road, the former on fills or light grades, the latter in cuts and over level, wet meadows.

Cases can be cited, also, where town commissions have contracted for resurfacing old macadam roads which, when the contractor began work, were found by him to consist of only the dirt pulverized from the original macadam stone—no stone as large as a chestnut to be found at all in the center of the road. To put a thin bituminous surface (2 or 2½ inches) on such a base is an almost total waste of money.

Before deciding to use old macadam as a base, an intelligent and thorough investigation should be made of its condition—the thickness of stone remaining; whether it has a telford foundation; whether, if it needs to be scarified and reshaped, this can be done without diminishing the solidity and strength of the old macadam; and whether the drainage is sufficient to prevent undue softening of the soil sub-base. If these conditions are satisfactory there is decided advantage in using old macadam in this way. But if they are not, the entire expense of the improvement may be wasted and the last condition of the road be worse than the first.

## PROGRESS IN PAVING.

In city and country alike, no other kind of public works has received as much attention during the past five years as paving; and it would therefore be strange indeed if great progress were not being made in the science and art of paving. This progress has been along a number of lines. Improved methods have been developed of making and of laying old materials. New materials have been experimented with and some adopted with success. Old materials have been put to new uses, or a new impetus given to the promotion of materials the use of which had previously made little headway—and finally, and by no means of least importance, paving contractors and engineers have advanced greatly in skill and knowledge.

In this issue we have endeavored to present descriptions of the latest developments in the several classes of pavement which are in general use. The methods and materials approved by leading authorities as being the best in bituminous pavement construction are described by Prof. Blanchard, probably the most prominent writer on the subject in the country; while descriptions are given also by our editorial staff of several special kinds of bituminous pavements. Prominent engineers have described the methods now advocated for laying brick and concrete pavements, and the use of stone block on county highway is described.

Each of the paving materials and methods described has merit which has been demonstrated by use; but each is better adapted to some conditions than to others. Kind and intensity of traffic, grade, climate, availability of materials used in construction, abundance, cost and skill of local labor are a few of these conditions. Knowing local conditions, it is necessary to know also the pavements from which choice can be made to meet them. And it is our aim to furnish this latter information in these articles.

## THE FEDERAL AID ROAD ACT

### Abstract of the Rules and Regulations for Carrying Out the Provisions of This Act Drawn Up by the Secretary of Agriculture.

Road building by the nation in co-operation with the states has been made possible by the passage by congress of the Bankhead-Shackleford bill, which appropriates \$75,000,000 for the construction of rural post roads in the states and \$10,000,000 for roads and trails in national parks or forests. For the fiscal year ending June 30, 1917, \$5,000,000 is appropriated; for the next fiscal year \$10,000,000 will be appropriated, and for the succeeding three years \$15,000,000, \$20,000,000 and \$25,000,000, respectively.

The Secretary of Agriculture, D. F. Houston, has drawn up rules and regulations for carrying out the provisions of the Federal Aid Road Act which went into effect September first, of which the more important are abstracted below.

In applying the law the term "rural post road" is defined to mean any public road over which the United States mails are or may be transported, excluding streets and roads in cities or villages which have a population, according to the last census, of over 2,500, except where the houses are more than 200 feet apart. Road is further defined as any road, trail or bridge.

After deducting an amount not to exceed three per cent for administrative purposes, the remainder is to be apportioned among the states, one-third on the basis of the area of the state compared with the total area of all the states, one-third on the basis of population and one-third on the basis of the mileage of rural delivery routes and star routes. The \$10,000,000 for improvements to roads in national parks and forests, after deducting ten per cent as a special fund, is apportioned: one-half on the basis of the area of the lands of the United States within the several states, and one-half on the basis of the value of timber and forage resources of the national forests in the state.

The management and distribution of the road building fund is in the hands of the Secretary of Agriculture, and states wishing to avail themselves of the benefits of the act must, through their highway departments,\* submit project statements, setting forth the proposed construction. These must contain all the information necessary to enable the Secretary to ascertain whether the project conforms to the requirements of the act, whether adequate funds will be available on behalf of the state, what purpose the project will serve and how it correlates with other highway work of the state, the administrative control of and responsibility for the work, the practicability and economy of the project from an engineering and constructing viewpoint, the adequacy of plans and provisions for proper maintenance and the approximate amount of Federal aid desired. Sketches, maps and samples of construction materials must accompany the project statement. The amount of Federal aid is not to exceed fifty per cent of the cost of the project. Engineering expenses are not to exceed ten per cent.

Surveys and plans must be complete and estimated costs for each item must be given. Rights of way are to be provided by the states. All expense of making surveys prior to actual construction is to be borne by the state. Grade crossings are to be avoided where possible and all costs for grade crossing elimination are to be paid

\*Highway Department is defined as "any department, or commission, or official or officials, of a State empowered, under its laws, to exercise the functions ordinarily exercised by a state highway department." The existence of such official body is a prerequisite to receiving federal aid.

by the state. Plans once approved by the Secretary cannot be changed without his consent.

Adequate advertising is required for all work, and the Office of Public Roads will have a representative present whenever bids are opened. Bids must show unit prices, and where contracts are awarded to other than the lowest bidder the Federal government will pay only its pro rata share of the lowest responsible bid, unless it is shown to be advantageous to accept the higher bid.

Bridges, viaducts and under-passes are to have, unless specifically stated otherwise, a clear width of roadway of not less than 16 feet and a clear headroom of not less than 14 feet for a width of 8 feet at the center. No part of the Federal money may be used, directly or indirectly, to pay "any premium or royalty in any patented or proprietary material, specification, process, or type of construction, unless purchased on open actual competitive bidding at the same or a less cost than unpatented articles or methods equally suitable for the same purpose."

A separate account of the work on each project is to be kept so that the costs and expenditures may be known at any time. Unit cost records are to be kept whenever requested by the Secretary. Payments may be made by the Secretary on receipt of vouchers showing amounts expended and amounts due from the Federal government, either monthly, at intervals greater than a month or at the completion of the work.

Under the provisions of the act, Federal aid will be apportioned as follows:

State.	Total.	State.	Total.
Alabama .....	\$1,608,000	Nevada .....	\$1,004,250
Arizona .....	1,076,250	New Hampshire....	324,750
Arkansas .....	1,272,750	New Jersey.....	912,000
California .....	2,336,250	New York.....	3,877,500
Colorado .....	1,302,000	New Mexico.....	1,235,250
Connecticut .....	478,500	North Carolina....	1,746,000
Delaware .....	124,500	North Dakota.....	1,176,000
Florida .....	840,750	Ohio .....	2,905,500
Georgia .....	2,079,750	Oklahoma .....	1,773,750
Idaho .....	941,250	Oregon .....	1,221,750
Illinois .....	3,432,000	Pennsylvania .....	3,585,750
Indiana .....	2,109,000	Rhode Island.....	180,750
Iowa .....	2,260,500	South Carolina....	1,111,500
Kansas .....	2,231,250	South Dakota.....	1,256,250
Kentucky .....	1,509,000	Tennessee .....	1,773,750
Louisiana .....	1,019,250	Texas .....	4,515,750
Maine .....	731,250	Utah .....	869,250
Maryland .....	662,250	Vermont .....	354,000
Michigan .....	2,259,750	Virginia .....	1,530,000
Minnesota .....	2,190,750	Washington .....	1,098,750
Mississippi .....	1,371,000	West Virginia....	825,750
Missouri .....	2,633,250	Wisconsin .....	1,983,000
Montana .....	1,512,750	Wyoming .....	956,250
Nebraska .....	1,660,500		

### A CONCRETE TESTING LABORATORY.

The Lewis Institute, of Chicago, and the Portland Cement Association will hereafter jointly operate a laboratory for making experimental researches in concrete and concrete materials. The laboratory occupies about 8,000 square feet of floor space and contains equipment for making the usual physical tests of concrete and the materials used in it. The institute has already carried out considerable concrete investigation work in cooperation with several technical committees of the American Society for Testing Materials. The experimental work already completed or in progress includes investigating the most satisfactory form of test piece for use in standard strength tests of cement; effect of fineness of grinding of cement on strength of mortar; studying the impurities affecting the concrete-making qualities of natural sands, and several others. Tests are being made at the rate of 40,000 per year.



# The WEEK'S NEWS

Georgia's New Highway Department—Schenectady's Gateway Project—Record Low Death Rate in United States—Work of State Health Boards of North Carolina, Indiana and Pennsylvania—Mississippi Municipal Utility Superintendents Organize—Water Right Litigation in California—New Situations in Kansas Natural Gas Case—Hearings Begin in New Jersey Rate Case—Michigan Cities Organize for Lower Rates—Erie's Conduit—Litigation Over Niagara Development—Detroit's Millionaire Police Chief—Borrowing by New York City—Commission Government Progress in New Jersey—Street Cleaning in San Francisco and New York—Pittsburgh's Fight Against Smoke.

## ROADS AND PAVEMENTS

### Highways of Michigan Upper Peninsula.

Marquette, Mich.—That nearly a million dollars will be available for upper peninsula highways in the next five years, and that most of this money will be spent on trunk lines already laid out, was announced at the meeting of the county engineers with State Highway Commissioner F. F. Rogers held here. Mr. Rogers predicted that \$400,000 of the \$2,000,000 federal appropriation will be spent in the upper peninsula, making the total sum available \$800,000 when the state has paid its half. It is believed that about \$75,000 will be available in 1917. One of the problems, according to Mr. Rogers, is to determine what part of the money that must be raised in Michigan shall be furnished by the state, and what part shall be furnished by the counties and townships directly benefited. Some of the richer counties will be willing to pay half of the amount to be spent within their boundaries in order to secure the other half from the federal fund. The counties whose valuations are low, and who are paying about all they can afford for road building now, will be assessed a smaller proportion. The federal aid fund in Michigan will be spent only for trunk line highways and roads of interstate importance, it is believed. The counties will make provisions for the building of subsidiary roads as usual.

### Unite to Fight Bone Patents.

San Diego, Cal.—To secure wider co-operation in contesting in the courts the claim of Frank Bone for alleged infringement of patents on a cantilever reinforced concrete retaining wall, City Attorney Cosgrove has asked the council that it authorize City Clerk Allen H. Wright to bring this matter to the attention of the league of California municipalities which meets at Visalia October 10 to 15. Wright is president of the league. If authorized, he will inform the convention of the status of litigation between Bone and the city of San Diego now pending before the state supreme court and will seek co-operation of all cities in the league. Bone's contention is that in constructing retaining walls at the University Heights reservoir and at the H or Market street bridge the city violated his patent rights. City Attorney Cosgrove has been advised that Bone has begun a similar suit against the town of Mill Valley. Attorney Cosgrove has secured the co-operation of the legal department of San Francisco to fight Bone's contention, and he desires the assistance of other cities that might become a party to similar suits.

### Highway Department for Georgia.

Atlanta, Ga.—The machinery through which the state of Georgia will be in position to receive from the federal government some \$2,000,000 for the purpose of constructing highways in this state has been perfected, the state highways department created by the last session of the general assembly, having been organized in the office of the state prison commission, which body forms the nucleus of the new department. Judge T. E. Patterson, of the prison commission, was elected chairman of the highways department. Captain Goodhue Yancey, secretary of the prison commission, was chosen secretary. The remainder of the personnel of the department, by the act of the general assembly, consists of R. E. Davison and E. L. Rainey, of the prison commission; state geologist S. W.

McCallie, professor C. M. Strahan, head of the engineering department of the University of Georgia, and professor R. D. Kneale, head of the engineering department of Georgia Tech. E. W. James, chief of maintenance in the United States office of public roads, was present at the organization meeting, and explained and discussed with the department the requirements made of Georgia in order to comply with the federal act and to receive federal aid under this act. There is available for the state of Georgia under the federal act approximately \$2,000,000 to be paid in increasing installments annually throughout five years, the first installment amounting to \$134,000 and the last installment amounting to \$600,000. In order to obtain this money from the federal government it will be necessary for the state of Georgia to put up its equivalent in money, labor, material or in any other way in which it desires to bear one-half the cost of road construction with the federal government. The state of Georgia has three years in which to make itself ready to receive the first installment from the federal government, and it is likely that the legislature will have to enlarge the powers of the Georgia highways department somewhat before it can share fully in the federal fund. The department is determined to do the most constructive work possible for the state, and if it does not succeed it will be through failure of the legislature to make such provisions as will amply finance the commission, give it additional power in the control of the convicts to the end of co-operating with the federal government, and other prerogatives. It will be months before the highway department shall have worked out the details of its co-operation with the counties. It will probably be found best in building the larger trunk roads across the state to place them under the direct supervision of the state department of highways rather than leave them to the counties.

### Report on Schenectady's Gateway Project.

Schenectady, N. Y.—William Barclay Parsons, appointed by State Engineer Frank Williams, and Richard Sutton Buck, appointed by Mayor George R. Lunn, to investigate the possibilities of a proposed bridge across the Mohawk to tie up the state highways of the Mohawk and Schoharie Valleys, have reported on the "Great Western Gateway Project." Engineers Buck and Parsons are in accord on all the important phases of the project: "That (1) it will not cause adverse flood conditions; (2) it is practicable to secure reliable foundations without excessive cost; and (3) the type of bridge proposed is in conformity with good modern practice, economical and well adapted to the purpose. We differ only as to certain details of construction, not essentially affecting the general proposition, and as to the probable cost which is largely dependent upon more or less indeterminate conditions." Mr. Parsons estimates the total cost at \$990,000, while Mr. Buck claims the bridge can be built for \$912,000. Furthermore, Mr. Buck asserts his belief that with economical management his estimate of \$912,000 may be decreased from \$100,000 to \$125,000. These costs include paving, but not railroad construction. The scope of the investigation included the following essential subjects: 1. Flood conditions relating to and as affected by the construction of this bridge; 2. Ground and foundation conditions; 3. Review of the plans and estimate of cost of the proposed bridge including approaches and rights of way. The location and preliminary design of bridge considered as the basis of this report are those made by John

A. Bense for the city of Schenectady. The bridge as designed is of reinforced concrete arches between piers carried on pile foundations, with concrete retaining wall abutments, and is designed to carry the heaviest urban traffic with two roadways, two sidewalks and two lines of electric trolley tracks. The alternative widths of bridges considered have been to provide 56-foot, 40-foot and 36-foot roadways, each alternative having two 7-foot sidewalks. The 40-foot roadway is adopted in cost estimates. The estimated total length of the structure is 3,880 feet; the length between approaches, 3,380 feet, and the length between abutments, 3,120 feet. In discussing flood conditions, the report says: "Therefore, in our opinion, the construction of the bridge will have no material effect on flood water level either above or below. Experience has shown that reinforced concrete bridges have endured perhaps more successfully than any other type of bridge, the attack of excessive and unanticipated flood and flood-carried drift."

#### University Students on Road Work.

Seattle, Wash.—An example of the co-operative work carried on by the university and the state of Washington is seen in the survey of a new route for the Sunset highway between Ellensburg and Wenatchee, in the eastern part of the state, this summer. Twenty sophomores in civil engineering, supervised by J. W. Miller, C. E. Newton and W. E. Duckering of the university faculty, laid out the route. The present road is 96 miles in length and passes through miles of sand in Grant county. The surveyed route is shorter by 29 miles and traverses a district that will be free of sand. Members of the state highway commission, when approached on the subject of a survey over the proposed highway, appeared convinced that a 5 per cent grade could not be obtained and therefore declared the project impracticable. The university disproved this and, according to Prof. Miller, an easy 5 per cent grade was laid out, much of the way following the Columbia river closely. Expenses of the project were borne jointly by the county commissions of Chelan, Kittitas and Douglas counties.

## SEWERAGE AND SANITATION

### Lowest United States Death Rate.

Washington, D. C.—The lowest death rate on record for the registration area of the United States is shown in the 1915 figures compiled by the United States Bureau of the Census. The rate of 13.5 per 1,000 estimated population establishes the new low mark. It was based on 909,155 deaths returned from 25 states (in one of which, North Carolina, only municipalities of 1,000 population and over in 1910 were included), the District of Columbia, and 41 cities in non-registration states. The total population of this area in 1915 was estimated at 67,337,000, or 67.1 per cent of the total estimated population of the United States. The states of North and South Carolina, which recently enacted the "model law" for the registration of births and deaths, were admitted to the death-registration area for 1916, increasing the estimated population of the area to 70.2 per cent of the total for the United States in that year. The most favorable year prior to 1915 was 1914, for which the rate was 13.6. It is markedly lower than the average rate for the five-year period 1901 to 1905, which was 16.2. The decrease thus amounts to 16.7 per cent, or almost exactly one-sixth, during a little more than a decade. When due allowance is made for the addition of many new states to the registration area between 1905 and 1915, and the comparison is confined to the group of registration states as constituted during the period 1901-1905—the present population of which is about one-fourth of the total for the country—there is still shown a very considerable decrease, from 15.9 to 14.3 per 1,000 population, or 10.1 per cent. This decrease, on the basis of the present population, would amount to 42,876 deaths. On the assumption that a corresponding reduction has taken place throughout the entire country this would indicate a saving of approximately 170,000 lives in 1915 for the United States as a whole. In the states for which death rates for 1901-1905 are given, the

greatest proportional decrease between that period and 1915 is shown for Rhode Island—16.9 per cent. Next in order are New York, with a decrease of 14.6 per cent; New Jersey, 14.3 per cent; Massachusetts, 12.7 per cent; Vermont, 9.3 per cent; Connecticut, 5.1 per cent; Indiana, 3.8 per cent; New Hampshire, 3 per cent; and Maine, 1.9 per cent. Michigan alone showed a slight increase—eight-tenths of 1 per cent. Among the cities having 100,000 or more inhabitants in 1910 the tendency is toward a still greater reduction in mortality. The following-named cities show, for 1915, decreases of 20 per cent or more as compared with the five-year period 1901-1905: Newark, N. J., 29.9 per cent; Atlanta, 28.4 per cent; New York City, 26.8 per cent; Los Angeles, 25 per cent; Jersey City, 24.9 per cent; Pittsburgh, 23.9 per cent; St. Louis, 22.9 per cent; Denver, 22.7 per cent; Providence, 22.3 per cent; Paterson, 21.9 per cent; San Francisco, 21.7 per cent; Fall River, 21.7 per cent; Louisville, 21.1 per cent; and Nashville, 20 per cent.

### Anti-Typhoid Vaccination Campaign.

Raleigh, N. C.—The state board of health has just closed a summer campaign in nine counties for vaccination against typhoid fever and finds that there were 48,000 people vaccinated from April 1 to September 18, compared with 52,000 vaccinated during the 1915 season. However, the work this season represents 18 per cent of the population of the counties in which the work was done, whereas the 1915 work procured the vaccination of only 13 per cent of the population of the counties in which that work was carried on. The counties that had vaccination work this season were Richmond, Bladen, Cabarrus, Alamance, Mecklenburg, Catawba, Union, Stanly, Scotland.

### Sewerage Improvements in Pennsylvania.

Harrisburg, Pa.—The state board of health has approved the following plans: Loyalsock Twp., Lycoming Co. (Val-lamont Land Company)—lateral sanitary sewer extensions. Harmony—approving plans for comprehensive sanitary sewer system and requiring that sewage treatment plans be submitted. Haverford Twp., Delaware Co.—approving preliminary district sewerage plans. Clinton Twp., Lycoming Co. (State Industrial Home for Women)—approving revised plans for sanitary sewerage and sewage treatment. Falls Twp., Wyoming Co. (Boys' Industrial School, Whites Ferry)—sewerage and sewage treatment. Grove City—approving changes in sewerage plans and extending time for construction of treatment works. Middlesex Twp., Cumberland Co. (Directors of the Poor and House of Employment of Cumberland Co.)—approving sewerage and sewage treatment plans. Warren—approving preliminary plans for intercepting sewers.

### Educational Work of Health Department.

Indianapolis, Ind.—By means of exhibits, lectures, circulars and books, the Indiana State Board of Health has reached 1,000,000 persons in the state in the last six years, according to figures contained in a resume of its work in that period. The public health exhibit prepared by the board has been shown in practically every important city and town in the state and has been visited by an average of 20,000 or more persons each year. In addition to the exhibit representatives of the board have given about 200 lectures a year, attended by about 50,000 persons each year. An average of 75,000 health circulars, treating on the subjects of communicable diseases, have been distributed by teachers in schools and used by them in their work. An average of seventy-five letters a day from residents of the state seeking information concerning health questions have been received and answered. In 1913 the legislature appropriated \$2,500 for the use of the board in preparing and printing a "Baby Book," for first mothers. In two years more than 10,000 of the books were distributed. In 1915 the legislature increased the appropriation for the book to \$4,000, but that has proved insufficient to supply enough books to meet the demand. Requests for the book have been received from every state in the Union. The Health Law of 1909 gave the board of health jurisdiction over the construction of schoolhouses throughout the state. Beginning in 1911, and including 1915, 493 new school buildings



were erected in the state at a cost of almost \$11,000,000, the sanitary features in each having been supervised by the board. This year the board has examined and approved plans for 105 new schools, ninety-two of which were in rural districts or small towns. The laboratory of bacteriology of the State Board has examined about 30,000 specimens each year, most of which were forwarded by physicians for purposes of diagnosis. The laboratory also furnishes free anti-typhoid vaccine to any citizen of the state. Under the provisions of the "Hydrophobia Law" 919 persons have received the Pasteur treatment from the board since 1911.

#### End of Infantile Paralysis Epidemic.

New York, N. Y.—Members of the Federal corps of research workers sent here under Dr. C. H. Lavinder to study poliomyelitis have calculated that by Nov. 15 there will be only ten cases of infantile paralysis to be reported a week. The entire corps is unanimous in declaring that poliomyelitis as an epidemic has passed. The new cases and deaths reported decrease in number every week. The total cases to date are 9,063 and the number of deaths, 2,308. Fear of the disease, however, is keeping children away from school. More than 200,000 pupils who had registered for attendance in the schools this fall were not in attendance on Sept. 27, according to figures published by the Board of Education. The number registered was 829,191 and the attendance 628,728. These figures include elementary, high, training, vocational and truant schools. The opening of the schools, however, seems to have had no effect on the number of new cases. The numbers of new cases up-state and in New Jersey are also decreasing and quarantine bans being gradually lifted.

### WATER SUPPLY

#### City Fights Watershed Assessments.

New York, N. Y.—The city is continuing its annual fight against the assessors in Westchester county because it is alleged they have illegally assessed the city's watershed properties. The city has obtained from Supreme Court Justice Arthur S. Tompkins, at White Plains, writs of certiorari against the assessors of the towns of Bedford, Lewisboro, New Castle and Mount Pleasant, directing them to show cause in the Supreme Court on December 1 why the assessments for 1916 should not be reviewed in court. The total assessment in the different towns is more than \$20,000,000.

#### Municipal Plants Organize.

Jackson, Miss.—Superintendents, managers and engineers of municipally-owned water works and electric light and power plants of the state at a meeting here have organized the Water and Light Society of Mississippi. M. L. Worrell, of Meridian, was elected permanent chairman, and W. W. Pointer, of Clarksdale, temporary secretary. A committee composed of Prof. R. C. Carpenter, of the A. and M. College, at Starkville; J. A. Steel, of Vicksburg and H. Converse, of Crystal Springs was chosen to report on constitution and by-laws. The object of the organization is to exchange experiences and ideas at gatherings, with the view to lowering, where possible, the costs of operation of municipally-owned public utilities, so that rates to consumers can, if possible, be reduced. Those at the head of the organization will write to the mayors of the various cities in Mississippi asking their co-operation in the association and its activities. While the organization is composed of managers and superintendents of plants in this state, it was decided to allow such men from other states the privileges of membership.

#### City Buys Waterworks.

Shreveport, La.—The city of Shreveport will buy complete the plant of the Shreveport Water Works Company for \$800,000, according to the offer it made the company. The company's acceptance was given at the expiration of the twenty-four hours allowed for a final answer. In addition the city council awarded contracts for a complete new pumping plant and equipment, filter plant and water softening system, the whole to cost \$305,047. The \$800,000

will come from the waterworks bond issue, the balance of which will be used in paying one-third cash for the new plants, the other two-thirds to be cared for by certificates of indebtedness to be paid out of the earnings of the water department in one, two and three years. The \$800,000 for the old plant is to be paid for the company's property free of encumbrances, delivery to be made December 31, 1916, the water company to be entitled to the earnings until that time. The action of the council was the culmination of a long series of negotiations for the purchase of the plant. After the plant had been examined and appraised at a sum exceeding a million dollars by Engineer Hawley, acting then as an expert of the city, the city asked the company what it would take for its property. The answer was \$1,415,000. This was rejected by the city and an offer of \$750,000 was made. The waterworks company refused this offer. The city then considered the construction of a new plant. After further negotiations, President Lynn of the company offered the property for \$1,000,000. He said this would entail a loss on the bondholders of approximately 33 1-3 per cent and the operating company would lose practically \$500,000. The city officials rejected the offer of the company and offered \$750,000 for the plant and \$50,000 additional if delivery is made within ninety days. This was accepted by the company.

#### Investigate Water Loss.

Appleton, Wis.—Chairman Walter Alexander of the Wisconsin railroad commission has requested the state engineering department at Madison to make an investigation of the Appleton water works plant. This action comes as the result of reports to the effect that the plant lost during the year ending June 30, 1916, approximately 64 per cent of the water pumped.

#### Reinstatement for Water Works Engineer.

Cleveland, O.—Gustave A. Stone, engineer in the water works department from May 30, 1903, until discharged at the beginning of the present city administration, is to be reinstated in his position by a decree of Common Pleas Judge George L. Phillips, unless a higher court decision intervenes. Judge Phillips rendered his decision in a suit brought by Mr. Stone against Thomas S. Farrell, director of public utilities, and Charles P. Jaeger, former acting head of the water department, to recover his position as engineer. The decision was favorable to Stone. The city immediately gave notice that it will fight the decree in the court of appeals. From the time Mr. Stone entered the water works service until 1907 he was a night engineer at \$1,300 a year. Then he was promoted to assistant chief engineer of the day force at \$1,500. In 1912 he was made engineer of the Kirtland pumping station at \$2,200. In 1914 he was put in charge of the Fairmount pumping station at \$2,400. In 1915 he was put in charge of the Warrensville and three other stations and in January, 1916, became engineer of water works construction at \$2,500 a year. On March 4, 1916, he was dismissed. Stone claimed that having served five years and more as engineer he was exempt from a civil service examination. He had been declared exempt by the civil service commission in 1914. The city contended that the charter clause granting immunity was unconstitutional and that Stone, because of promotions, had not served five years in one position. Judge Phillips held the clause constitutional. The court held there is no appeal from the civil service commission's ruling and that as it had held in 1914 that Stone was no longer subject to civil service examinations that act entitled Stone to recover his position.

#### To Arbitrate Water Rights.

San Francisco, Cal.—Facing litigation from the farmers of the Alameda county water district, which menaced the right of the Spring Valley Water Company to store the waters of Alameda Creek in the new Calaveras reservoir, the company has consented to a plan of arbitration under which the three appointed members of the state water commission are given three years to determine the respective rights of the parties before rendering their decision. In the meantime the water company obligates itself to release sufficient water from the Calaveras reservoir to keep the wells in the "Niles cone" at the normal level of the year 1914. On

the other hand, the farmers agree not to object to the water company enlarging its delivery to San Francisco, provided the water table is not lowered in the gravel beds from which their wells draw. The three members of the commission who will constitute the arbitration board, whether they remain in their present state offices or not, are Irving Martin, A. E. Chandler and W. A. Johnstone. While the arbitration is pending the parties agree to allow the pending suit to rest and to dismiss it when the arbitrators render their decision, which it is agreed shall be binding. Spring Valley agrees to pay the expenses of the three years' investigation up to the amount of \$10,000 a year. Should the city of San Francisco purchase the Spring Valley properties it would find itself bound by the terms of this agreement and forced to open the gates of the Calaveras dam whenever the Alvarado farmers run short of water in their wells.

## STREET LIGHTING AND POWER

### The Kansas Natural Gas Tangle.

Independence, Kan.—General interest in the natural gas controversy shifted to this city, when Victor A. Hays, president of the Kansas Natural Gas Company, filed an application in the Montgomery county district court for the discharge of the receiver and the restoration to the stockholders of that great property, valued at approximately \$16,000,000. This move follows closely upon the recent motion of Attorney General Brewster of Kansas, and the two have practically the same object. Mr. Hays has, in this action, the unanimous authority of the 750 stockholders of the Kansas Natural Gas Company, who recently proposed a new issue of stock for the purpose of discharging the \$3,250,000 of indebtedness, netting a sum of approximately \$1,750,000 for extensions of pipe lines to reach more remote gas-producing fields and the institution of a general system of improvement. The proposed campaign of expansion would place the property in the best physical and financial condition. It was stated in the petition drafted by the attorneys that reasons for the receivership, namely, the "correction of corporate abuses," had been eliminated. The dissolution of the receivership was asked, the petition avers, because of obligations resultant from the creditors' agreement of December, 1914, and the necessity for extensions into Oklahoma gas fields. Provisions also were made in the petition setting forth the amount of indebtedness and the method by which it will be met. Officials purpose to raise \$4,500,000 by the issuance of \$9,000,000 of new stock to be placed on the market at 50 per cent. par value. That sum, it was explained, will cover the indebtedness, which approximates \$3,250,000, and will provide a working capital with which the officials can make extensions. It was set forth further in the petition that the proposed issue of stock would leave the Kansas Natural and the Kansas City Pipeline Company and the Marnett Mining Company, its subsidiary companies, wholly unencumbered. The capitalization present and proposed, of the Kansas Natural at the end of the receivership would aggregate \$14,250,000. Corporation papers of the Kansas Natural were issued in Delaware. The petition states the laws of that state permit the issuance of stock under the conditions faced by the Kansas Natural. It was asked in the petition, therefore, that the state of Kansas be prohibited from interfering with the proposed issue of stock.

Topeka, Kans.—S. M. Brewster, attorney general, refuses to approve the plan of reorganization of the Kansas Natural Gas Company as submitted by the attorneys for the company and the receiver. It is expected that Judge Flannelly will approve the plan and dismiss the receiver whenever the conditions of the plan are fulfilled. The attorney general is expected to file objections to the plan of reorganization when it comes before Judge Flannelly. When these objections are filed and then overruled by Judge Flannelly, then the state may appeal from the ruling and take the case to the supreme court, which can overturn the decision of Judge Flannelly permitting the reorganization, or it can approve it. The issuance of \$9,000,000 worth of stock, to be sold at 50 cents on the dollar, thus creating a large stock valuation, and the demand that the Montgomery county

court prohibit the state from interfering with the reorganization or taking any further action in the anti-trust suit, are the points on which the attorney general bases his refusal to approve the plan.

Following repeated orders and threats by the Kansas public utility commission the Kansas Natural Gas Company filed a schedule of the new rates it is putting in effect. The state commission will be asked to approve the new rates, although under a recent decision of the supreme court it is probable the Kansas Natural Gas Company will seek to establish the new rates with the October reading. Two Kansas towns—Independence and Coffeyville—draw lower rates than under existing schedules. The reduction of rates in these towns is due to proximity to Kansas-Oklahoma gas fields, it is explained; and the new schedule is based entirely on distance from supply fields. The new schedule includes the 50-cent minimum for Topeka, the minimum being effective for the first 3,000 feet, with a 35-cent flat rate for gas in excess of 3,000 cubic feet a month. No rate was filed for Kansas City, Kans., or Rosedale. The schedule said that the Wyandotte County Gas Company had refused to make a rate that was satisfactory, so the Kansas Natural would collect 18 cents at the city limits. The Wyandotte County Gas Company has filed a rate of 30 cents for both cities. The Kansas utilities board was enjoined by the federal court from enforcing the 28-cent rate, which it had established. The federal court further said that in its opinion a rate lower than 32 cents was not justified. However, the state board was not enjoined from any other than the 28-cent rate.

Governor Capper has issued a statement that if a justification is to be made of increased gas rates, the increase must be placed on industrial gas. The statement was based on a report received from Alton D. Adams, public service engineer, of Boston, who stated that in 1914 industrial gas amounted to 57.5 per cent. of the total and returned less than a third of the revenue. Figures furnished by Adams show that more than 26,000,000 cubic feet of natural gas was used for industrial purposes in Kansas in 1914 at an average of 8.70 cents a thousand, while 19,000,000,000 were sold for domestic use at 25.49 cents a thousand feet. With these rates, domestic sales yielded \$4,898,314 and industrial sales only \$2,265,432, though industries consumed 57.5 per cent. of the total. An increase of 5 cents a thousand would have increased the revenues from industrial gas \$1,300,000 for the year. Figures by Adams also show that in 1914 Kansas produced 22,000,000,000 cubic feet of gas, or \$3,000,000,000 feet more than was used for domestic purposes. The report shows forty cities have domestic rates of from 10 to 25 cents a thousand cubic feet.

### Hearings in New Jersey Rate Case.

Trenton, N. J.—With more than a score of municipalities represented the board of utility commissioners began hearings upon the petitions of Newark, Jersey City and other municipalities, asking for the establishment of separate rates by the Public Service Electric Company in place of the state-wide rate now in force. There has been a change in viewpoint on the part of some of the smaller municipalities. These apparently fear that the lowering of rates in the larger and more congested communities would in all probability result in increased rates in the smaller communities where the expense of service is greater. This was indicated when the representatives of Verona and Linden withdrew their petitions, thereby ceasing to be parties to the application. President Ralph W. E. Donges of the board explained at the outset that no conclusions would be expressed as the direct outcome of the hearing, which will be only one factor in the final disposition of the general question as to the reasonableness of the rates charged by the Public Service Electric Company. The position of Jersey City was outlined by John Milton, who contended that the rates charged in that community were inequitable and unfair and did not bear a proper relation to the class of service in Jersey City as compared with that in more sparsely settled districts. He submitted that the fixing of a rate should be contingent upon the investment made by the corporation in its physical properties, plus expenses and a fair return. Appearing for Hoboken, John J. Fallon argued that the rates now charged in that municipality are unreasonable. He



submitted that Hoboken should receive considerable from the company because it granted the franchises to do business. An investigation, he asserted, would show that Hoboken is a source of large profit to the company, and he argued that the rates should be based upon the area supply, the amount of energy used and the amount consumed. "The only fair returns to which the company is entitled," said Mr. Fallon, "should be based upon the sworn statement made to the taxing authorities, and not upon fancy figures submitted for the purpose of rate making." That congested municipalities should get the benefit of lower rates as a whole, but not as a zone, was the argument advanced by William C. Aspen, who appeared for Weehawken. There should be no distinction in the distribution of energy in such communities, he added, since boundary lines in this connection are only imaginary. Other communities represented included East Newark, Union Hill, Nutley, Cranford, Westfield and a number in Bergen county.

#### Michigan Cities Organize.

Highland Park, Mich.—At a meeting held here of a number of cities on the North Shore, a new organization was formed with the immediate aim of obtaining better gas rates from the North Shore Gas Company. The company, through G. F. Goodnow, its president, has offered to reduce the rate to 90 cents a thousand feet after the first 2,000. In spite of the vigorous opposition of Waukegan representatives who pointed out that most consumers did not use 2,000 feet per month, the other members seemed inclined to accept the offer. A committee was sent to ask the Utilities Commission which is hearing the case to grant a month's delay. The North Shore Association has several objects, mainly the promotion of a closer bond of sympathy between the various municipalities. The regulation of the automobile speed and traffic is one of the purposes. An effort will be made to make uniform speed restriction through all the North Shore cities so that motorists may know just what to expect. A uniform tax rate is another purpose. Regulation of sewer and water problems also will be brought up and remedies sought where they are deemed necessary. Officers were elected as follows: President, Mayor Hastings, Highland Park; vice-president, Mayor W. M. Lewis, Lake Forest; secretary, City Clerk E. A. Warren, Highland Park; treasurer, Mayor Rummell, Winnetka; counselor, Attorney Sam Holmes, Highland Park.

#### City Conduit Found Inadequate.

Erie, Pa.—The contention of the Erie County Electric Company that the State street conduit as now constructed is inadequate for its needs has been substantiated by the city's expert. Reporting on his survey of the system, George E. A. Fairley, principal assistant engineer, electrical commission of Baltimore, Md., told council that extensive changes are necessary. Although he had acted on instructions of the mayor and had not seen statements of changes desired by electric companies, the expert's statement agreed in many details with the report submitted by Thomas G. O'Dea, general manager of the Edison Company. As the conduit system is now constructed it is not in condition for occupancy by two electric companies, Mr. Fairley reported. Distributing manholes and main trunk manholes are entirely too small, was the main trouble found. In his opinion there is no reason why high and low tension wires should not occupy the same main manholes, the expert stated, and the different companies distributing electric power here should not object to the common use of the system when considerable reconstruction is done. The defects pointed out by Mr. Fairley were:

1. The main trunk manholes at street intersections are entirely too small and too shallow, and as now constructed will not permit of a safe and satisfactory arrangement of cables.
2. Existing distributing manholes are entirely too small, improperly shaped, and should not be constructed on top of the main trunk line except over at least five-foot cover.
3. Mistake has been made in planning house connections directly from main manholes at street intersections.
4. Transformer manholes should be constructed alongside of and not in line with main conduit trunk line.
5. Medium sized single ducts as now used in the system should be superseded in the future by three and one-half inch internal bore square section duct.

Numerous recommendations for a practical reconstruction

of much of the conduit system were made by the expert. In this connection he stated:

Care should be taken to properly arrange cables in manholes, and no cables should be laid except by permission and under direct supervision of the city electrician.

In the reconstruction of distributing manholes the side walls should be constructed in box form, and not tapering as at present.

Removal of wires from overhead poles should be studied so that eventually a system may be completed that will include all main business streets, and principal nearby streets. Otherwise the city will have an unsatisfactory patch-work system that may entail rebuilding at great cost.

To enable each electric company to have separate conduit systems on opposite sides of the street, the distributing boxes on either side of the thoroughfare should be connected with not less than six ducts capacity.

Enormous future increase in use of electric power here will absolutely necessitate a conduit system in Erie. The overhead conditions of State street are dangerous and will grow steadily worse.

If proper precautions are taken in the installation of electric feeders in the conduit, there should be no serious trouble and no serious risk to the citizens of the city should be occasioned.

After this report was presented, the expert was asked to make a supplementary report on changes asked by electric companies. Convinced that reconstruction is essential, council decided to contract with Mr. Fairley for revision of the State street conduit plans. The council has asked A. P. Michaels, Cleveland, who designed the system, to come here in defense of his work and for conference with councilmen.

#### Niagara Power Litigation.

Toronto, Ont.—Defeated in its attempt to have a fiat granted, aimed at the Chippawa Creek development, the Electrical Development Company of Ontario, Limited, has issued a writ against the Attorney-General and the Hydro-electric Power Commission of Ontario. Plaintiffs claim that the commission has not the legal right, either with or without the consent or authority of the Lieutenant-Governor in Council, pursuant to the Ontario Niagara development act, to divert water from any part of the Niagara or Welland rivers for the purpose of developing electrical or pneumatic powers, and that the Lieutenant-Governor in council has no right or legal power, pursuant to the Ontario Niagara development act or the waterpowers regulation act, 1916, or otherwise, to make use of the waters of the Niagara river for the production of electric power, or to authorize the Hydro Commission to do so, or to regulate or interrupt the use of such waters by the plaintiffs. The plaintiffs further claim an injunction to restrain the commission from diverting any water from any part of the Niagara or Welland rivers for the purpose of developing electric power. Hon. L. B. Lucas, attorney-general, took the view that there was no authority to issue such a writ at all. He could not see how any such action could be brought against the attorney-general, and as regards the Hydro Commission he pointed out that the power commission act sets forth that "without the consent of the attorney-general no action shall be brought against the commission or against any member thereof for anything done or omitted in the exercise of his office."

## FIRE AND POLICE

#### Fire Auto Burned.

Pompton Plains, N. J.—The fighting of flames, which broke out in early morning in a barn and destroyed several buildings, was paralyzed when the automobile chemical fire engine of the Pompton Plains Fire Department, which was stored in the barn, was destroyed. The fire, which is supposed to have been of incendiary origin, did damage estimated at \$15,000. Pumping apparatus, which came from the Bloomingdale and Pompton Lakes departments, could not get into service because of the absence of any hydrants in this section.

#### Ordinance Follows Black Tom Explosion.

Jersey City, N. J.—Railroads having terminals in Jersey City have been notified by director of public safety Frank Hague that a new ordinance to safeguard the city against the shipment of dangerous munitions and high explosives has gone into effect. The new regulation requires that cars carrying munitions or explosives shall be labeled to distinguish them from other freight cars and that such freight

shall be unloaded only in the daytime, shall be sidetracked on special tracks used for no other purpose, and shall be handled at once. The penalty for a violation of the ordinance is a fine of \$250. Indictments following the investigations of the explosion are now before the new grand jury of Hudson county.

#### Chief Hurt in Fire Auto Collision.

Orange, N. J.—Fire Chief William H. Matthews of Orange was injured and two of the fire machines were damaged in a collision, due to an error in taking the numbers as they sounded for a fire. No. 1 hose auto caught the full force of the impact head on and the frame was twisted and the crank case of the motor broken. Truck No. 2 escaped with a broken runboard.

#### Fire Leaves City in Darkness.

Findlay, O.—Fire which started late at night in a shed adjoining the three-story plant of the Findlay Carriage Company, destroyed that building and eight others, entailing a loss estimated at \$100,000. All wire communication with the exception of a telephone wire was cut off. Cables to the city lighting plant were destroyed and the town was thrown into darkness. The fire is supposed to have resulted from spontaneous combustion. Following an explosion, the carriage works burst into flames. The blaze, fanned by a southwest wind, sent sparks into the other buildings, which were quickly ignited. Houses four and five blocks away caught fire, but bucket brigades saved these structures.

#### Multi-Millionaire Police Chief.

Detroit, Mich.—Following the resignation of John Gillespie, Mayor Marx has appointed James Couzens, multi-millionaire and former vice-president of the Ford Motor Company, police commissioner. The removal of Commissioner Gillespie was for political campaign reasons and the action was taken with Gillespie's consent after his administration of the office had been subjected to continual criticism. Mr. Couzens will fill out Gillespie's term and if Mayor Marx is re-elected will continue. Mayor Marx offered him the position "without strings." Commissioner Couzens has for four years been street railway commissioner under Mayor Marx.

## GOVERNMENT AND FINANCE

### New York's Borrowing.

New York, N. Y.—Commissioner of accounts Leonard M. Wallstein has sent to mayor Mitchel a report made up of a group of tables showing the corporate stock transactions of New York City from Jan. 1, 1906, to Jan. 1, 1916. The report shows that under the strict retrenchment of the present city administration the commitments against the city's borrowing capacity were brought down 86.9 per cent below that of the McClellan period and 87.7 per cent below the average rate under mayor Gaynor. On Jan. 1, 1898, the report sets forth, the greater city began business with a funded debt reported by the controller as amounting to \$321,905,514.09. By Jan. 1, 1906, the controller reported that the funded debt had increased to \$565,056,512.75. In the ten years embraced in the report new bond debts of \$732,045,333.86 were incurred, but redemptions in those years left the total funded debt outstanding on Jan. 1, 1916, as reported by the controller, at \$1,121,671,536.35, plus \$33,812,284.93 in corporate stock notes to be redeemed from future bond sales. The authorizations for ten years are set forth as follows: McClellan administration, 1906 to 1909, \$409,668,458.52; the Gaynor administration, 1910 to 1913, \$351,807,993.85, and the Mitchel administration, 1914 to 1915, \$26,795,952.17; a total for ten years of \$788,272,404.54. The report says that except in assessments and expenses of commissions and boards, there has been an enormous decrease in authorization of corporate stock, and it explains the increase thus: "The 'pay-as-you-go' policy is also reflected in the ceasing under the Mitchel administration of authorizations for furniture and fixtures, repairs, street and park improvements, and experimental work. This policy had been applied to the Department of Docks and Ferries in the

Gaynor term, so that expenses of that department, previously met by bond issues, have been provided for out of the tax levy since 1909, the receipts of the department going into the general fund. "The apparent increase in assessments is due to the segregation of amounts previously included under the funds for street and park openings and street and park improvements. The true comparison is obtained by lumping these funds, showing that the average annual authorizations for these purposes were \$9,018,153.40 under McClellan, \$3,980,348.32 under Gaynor, and only \$1,546,786.04 under Mitchel. The other apparent increase in expenses of commissions and boards was due to the capitalization of the cost of engineering and other rapid transit expenses which had been met out of special revenue bonds. The amount of such debts thus founded in 1914 was \$3,543,000, and similar expenses of the court house board, amounting to \$67,816.89, were thus provided for."

### Commission Government in New Jersey.

Trenton, N. J.—Of the sixty municipalities that have voted on the Walsh act in the state so far, four made three attempts before they obtained commission rule, and three cities had to vote twice. In only one community in the state (Rahway), where there has been more than one test, has commission government lost out. The rule has been a growing sentiment for the Walsh act sufficient to prevail ultimately in spite of opposition by political machines and special interests. Commission government appears to be successful under adverse circumstances, due to defects in the law. When the opponents of commission government amended the Walsh bill in the legislature of 1911, so as to require a 30 per cent vote in favor of the adoption of the act to make it effective, they overlooked another provision of the law dealing with majorities, which reads: "If a majority of the votes cast are not in favor of the adoption of this act then the provisions of this act shall remain inoperative and no further proceedings shall be taken until after the beginning of the last year of the term of the mayor, or equivalent officer, elected at the election following the rejection of this act." The question as to whether the word "majority," as used in this provision, means more than half of the vote cast or is to be construed to be equivalent to a minority in case 30 per cent of the voters have not cast their ballots in favor of the act, is to be decided by the Supreme Court as a result of mandamus proceedings begun by a West Hoboken citizen. A majority of the voters who voted at the commission government election there last June favored the change, but they lost because they lacked a few votes of constituting 30 per cent of the voters. They immediately secured a new petition for another election, but the town clerk refused to accept it. Should the court hold that the word "majority" has its ordinary meaning in the Walsh act, then there will be a second election in West Hoboken.

### Reassessment Upheld.

Annapolis, Md.—The Court of Appeals has handed down a lengthy decision, written by Judge Burke, in which the authority of the Tax Commission to conduct a general reassessment of property is upheld. The question was before the court upon appeal from the Circuit Court for Frederick County, in which Judges Urner, Peter and Worthington had decided that the commission lacked authority, because the people in 1915 adopted an amendment to the state constitution providing for separate classifications for property for purposes of taxation, and the legislature of 1916 failed to enact measures giving the Tax Commission the machinery necessary to carry out the intent of the amendment. Judge Burke's opinion stated that, while the legislature alone could provide the classifications, and while the last legislature failed to do that, "it does not follow as a result of its failure of duty in this respect that any valid laws relating to assessments may not be availed of for that purpose. The authorities appear to be uniform in support of the proposition that the failure of the legislature to discharge a duty of the character imposed by this amendment leaves the valid and existing laws, not in conflict with any of its provisions, in full force and effect." The Tax Commission immediately will complete



its arrangements for the reassessment. Most of the machinery had been provided when the litigation arose, and very little will have to be done. The commission expects to complete its reassessment before cold weather sets in. One reason that the Court of Appeals was asked to hear the case before the regular October term was that the commissioners feared it would be impossible to assess the mountain property during the winter. The state officials confidently expect the new assessment to make a large increase in the taxable basis of the state, and consequently a big increase in the revenues. There will be no reassessment in Baltimore City, the commission having held that property there is under a system of constant reassessment, and it being recognized that the average assessment is not less than 80 per cent.

## STREET CLEANING AND REFUSE DISPOSAL

### Street Cleaning in San Francisco.

San Francisco, Cal.—San Francisco spent \$351,150 during the last fiscal year for sweeping and sprinkling its streets, according to the annual report of P. J. Owen, superintendent of the street cleaning department, filed with the board of public works. The average number of sweepers and foremen employed per day was 150, and the average number of teams employed daily was 56½, and they removed 116½ loads of dirt per day. During the year the city, by accepting streets, added 5,200,000 square feet to the area that is being cared for by the street cleaners, and the city has now 460 miles of streets to be swept. In the year's work the cleaners swept 626,895,890 square yards of street surface. They sprinkled and washed 352,609,616 square yards and flushed 62,510,000 square yards of gutters. During damp and foggy weather they sprinkled with sand 464 blocks of pavement.

### Co-ordinating Street Cleaning Activities.

New York, N. Y.—The first move in a large scheme to co-ordinate the activities of various city departments in the work of cleaning up the city was made when a committee of citizens appointed by the mayor toured three boroughs in an all-day automobile ride with Police Commissioner Arthur Woods and Street Cleaning Commissioner John T. Fetherston. The committee will make other trips of inspection and will report its recommendations to the mayor. Its object, as outlined by the mayor, is to determine whether the proper co-operation exists between the various departments and whether conditions can be improved. Those interested believe the scheme embodies one of the most thorough efforts ever made here to establish the problem of city cleanliness on a broad and permanent basis. The members of the mayor's committee include E. H. Outerbridge, representing the chamber of commerce, of which he is president, chairman of the executive committee; John C. Eames, the Merchants' Association; R. R. Appleton, of the Central Mercantile Association; Dr. S. S. Goldwater, former health commissioner, of the Academy of Medicine; Secretary Kennedy of the Anti-Litter Company, and S. G. Rosenbaum, president of the National Cloak and Suit Company, through whose efforts the movement was started.

### City Starts Own Collection.

Berkeley, Cal.—The city council has decided to undertake the collection of the city's refuse. This business has for years been in the hands of contractors who admit that they have been collecting from householders between \$3,000 and \$4,000 per month. When the council advertised for bids some were received offering from \$350 to \$500 per month for the sole privilege of collecting garbage in the city and the contractors who at present operate in the city asked the council permission to further increase their offer. It is proposed to form a special department called the department of collection of refuse, which will be placed under the control of either the mayor or the commissioner of public supplies. A position called "superintendent of refuse" will be created and this position has been offered to E. A. Brown, who tendered the most favorable bid for the col-

lection of city garbage. Brown's plan calls for four motor trucks, two of which would be exclusively used for collections in the central and more densely populated sections of the city, while the other two trucks would be utilized in the sparsely settled sections and would answer special and extra calls. It is anticipated that the equipment will cost under \$10,000 and money will be appropriated for this purpose. A system is being evolved whereby it is expected that receipts will be given for all moneys received and the collections will be made on a particular day each month. It has been pointed out that much dissatisfaction has hitherto existed in the city owing to the loose method of collection employed by contractors. After the equipment has been paid for the council hopes to be able to evolve some plan whereby it will be possible to make the collection of garbage without charge to the householders. In addition to the income that will be derived from the collection fees the city will segregate such material in the collections that can be sold. Four truck drivers and ten laborers will be employed to do the collecting. Each truck driver will be held, as foreman, personally responsible for the conduct of the men and will see that the collections are made in the cleanest and most sanitary manner possible. He will also be directly available to anyone who has a complaint or communication to make, blanks being provided for this purpose. The contractors, who have been collecting for fifteen years, employ thirty-two men.

## MISCELLANEOUS

### Smoke Elimination in Pittsburgh.

Pittsburgh, Pa.—Prosecution of the warned offenders who persist in violating the city anti-smoke ordinance will be started this month by J. W. Henderson, chief of the bureau of smoke regulation, the third notice having been sent out, which gives all persons not having smoke abaters already installed a chance to avoid prosecution. Active in the "Smoke Abatement Week," which has been arranged for the week of October 23, will be the Chamber of Commerce, the Allegheny County Civic Club and other civic organizations. This will have no effect on the date set for prosecuting offenders, but will be the time selected to announce when violators may expect arrest. To stimulate giving donations for the observance of smoke abatement week, the directors of the Chamber of Commerce have decided to make the chamber's contribution equivalent to the aggregate subscriptions of all other civic organizations in the membership of the Smoke and Dust Abatement League. The fund will be spent under the direction of the Chamber of Commerce through the Smoke and Dust Abatement League and the Mellon Institute for Industrial Research. A difficult problem for the smoke division of the city has been to get the owners of river steamboats to act. As a result of the demonstration of the Pennsylvania Lines east, showing that the coal bill could be cut in half by the equipment, several steamboat companies are preparing to install consumers.

### City Employees Protected from Loan Sharks.

Los Angeles, Cal.—Following up her campaign to loosen the grip of the loan sharks on city employes, councilwoman Lindsey had the council direct the city auditor to pay all city employes semi-monthly instead of once a month. This was the second step in the fight of the public welfare committee, of which councilwoman Lindsey is chairman, to do away with the practice of city employes assigning their salaries to loan sharks in order to raise ready money. The first step was to instruct the city attorney to report the necessary procedure for the establishment of a provident fund by the city from which loans might be made to city employes. Councilwoman Lindsey stated that "if the city paid its employes more frequently there would not be the need for them to assign their salaries to meet an emergency caused by sickness or other misfortune. Until the revolving fund is established from which loans may be made the city employes the least we can do is to provide that the employes receive their salaries every two weeks." The plan will necessitate a charter change, which will be put up to the people probably at the next special election.

## NEWS OF THE SOCIETIES

### Calendar of Meetings.

**Oct. 2-6.**—PLAYGROUND AND RECREATION ASSOCIATION OF AMERICA. Congress, Grand Rapids, Mich. Secretary, H. S. Braucher, 1 Madison avenue, New York City.

**Oct. 6.**—NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION. Study and conference, Deming Hotel, Terre Haute, Ind. Secretary, Will P. Blair, Cleveland, O.

**Oct. 9-11.**—NATIONAL HOUSING ASSOCIATION. Annual meeting, Providence, R. I. Secretary, Lawrence Veiller, 105 East 22d St., New York City.

**Oct. 9-13.**—AMERICAN ELECTRIC RAILWAY ASSOCIATION. Annual convention, Atlantic City, N. J. Secretary, E. B. Burritt, 8 West 40th street, New York City.

**Oct. 9-13.**—AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Twenty-third Annual Convention, Robert Treat Hotel, Newark, N. J. Secretary, Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind.

**Oct. 10-11.**—CENTRAL STATES DIVISION, AMERICAN WATERWORKS ASSOCIATION. Twentieth annual convention, Hollenden Hotel, Cleveland, O. Secretary, R. P. Bricker, Shelby, O.

**Oct. 10-12.**—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS. Secretary, R. W. Cotterill, Seattle, Wash.

**Oct. 10-15.**—LEAGUE OF CALIFORNIA MUNICIPALITIES. Annual meeting, Visalia, Cal. Secretary, H. A. Mason, Pacific Bldg., San Francisco, Cal.

**Oct. 11.**—UNION OF BRITISH COLUMBIA MUNICIPALITIES. Annual convention, Vernon, B. C. Secretary, Ex-Reeve H. Bose, Surrey Center, B. C.

**Oct. 11-13.**—LEAGUE OF KANSAS MUNICIPALITIES. Annual meeting, Independence, Kan. Secretary, C. H. Talbot, University of Kansas, Lawrence, Kan.

**Oct. 12-14.**—LEAGUE OF WASHINGTON MUNICIPALITIES. Annual convention, Everett, Wash. Secretary, Dr. Herman A. Brauer, University of Washington, Seattle, Wash.

**Oct. 13, 14.**—SOCIETY FOR STREET CLEANING AND REFUSE DISPOSAL. Annual convention, Street Cleaning Department Building, New York City. Secretary, J. R. Buchanan, Municipal Bldg., New York City.

**Oct. 14-21.**—NATIONAL SAFETY COUNCIL. Fifth Annual Safety Congress, Detroit, Mich. Secretary, W. H. Cameron, Continental and Commercial Bank, Chicago, Ill.

**Oct. 17-20.**—AMERICAN GAS INSTITUTE. Annual meeting, Chicago, Ill. Secretary, G. G. Ramsdell, New York City.

**Oct. 18-19.**—LEAGUE OF MINNESOTA MUNICIPALITIES. Annual convention, Red Wing, Minn. Secretary, Richard R. Price, University of Minnesota, Minneapolis, Minn.

**Oct. 24-27.**—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual Convention, Cincinnati, O. Secretary, Prof. Selikar M. Gunn, Boston, Mass.

**Oct. 26-28.**—LEAGUE OF TEXAS MUNICIPALITIES. Annual convention, Hillboro, Tex. Secretary, Prof. H. G. James, University of Texas, Austin, Tex.

**Nov. 15.**—ILLINOIS MUNICIPAL LEAGUE. Annual convention, Urbana, Ill. Secretary, John A. Fairlie, University of Illinois, Urbana, Ill.

**Nov. 15-16.**—NATIONAL CONFERENCE ON UNIVERSITIES AND PUBLIC SERVICE. Third annual conference, Philadelphia, Pa. Secretary, Edward A. Fitzpatrick, Box 330, Madison, Wis.

**Nov. 16-18.**—FIRE MARSHALS' ASSOCIATION OF NORTH AMERICA. Annual convention, Nashville, Tenn.

**Nov. 20-22.**—MONTANA MUNICIPAL LEAGUE. Annual meeting, Lewiston, Mont. E. S. Judd, City Clerk, Billings, Mont.

**Nov. 20-23.**—CITY MANAGERS' ASSOCIATION. Third annual convention, Springfield, Mass. Secretary, O. E. Carr, Niagara Falls, N. Y.

**Nov. 21.**—MASSACHUSETTS CIVIC LEAGUE. Conference and annual meeting, Springfield, Mass. Secretary, Edward T. Hartman, 3 Joy Street, Boston, Mass.

**Nov. 22, 23.**—MUNICIPAL RESEARCH WORKERS. First annual conference, Springfield, Mass. L. D. Upson, Program Committee, Detroit, Mich.

**Nov. 22, 23.**—TRAINING SCHOOL FOR PUBLIC SERVICE. Special conference, Springfield, Mass. Charles A. Beard, Supervisor, 261 Broadway, New York.

**Nov. 23, 24.**—CIVIC SECRETARIES' CONFERENCE. Annual conference, Springfield, Mass. Secretary, Howell Hart, Milwaukee, Wis.

**Nov. 23-24.**—MASSACHUSETTS FEDERATION OF PLANNING BOARDS. Annual convention, Springfield, Mass. Secretary, Arthur C. Comey, Cambridge, Mass.

**Nov. 23-25.**—NATIONAL MUNICIPAL LEAGUE. Annual convention, Springfield, Mass. Secretary, Clinton Rogers Woodruff, 705 North American Building, Philadelphia, Pa.

**Dec. 27-30.**—AMERICAN ECONOMIC ASSOCIATION. Annual meeting, Columbus, Ohio. Secretary, A. A. Young, Ithaca, N. Y.

**Dec. 27-30.**—AMERICAN STATISTICAL ASSOCIATION. Annual meeting, Columbus, O. Secretary, Carroll W. Doten, 491 Boylston street, Boston, Mass.

**Dec. 26-31.**—AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE. Annual meeting, New York City. Secretary, L. O. Howard, Smithsonian Institute, Washington, D. C.

**Jan. 20, 1917.**—WESTERN PAVING BRICK MANUFACTURERS' ASSOCIATION. Kansas City, Mo. Secretary, G. W. Thurston, 416 Dwight Bldg., Kansas City, Mo.

**Jan. 23-25, 1917.**—AMERICAN WOOD PRESERVERS' ASSOCIATION. Annual meeting, New York City. Secretary, F. J. Angier, B. & O. Mt. Royal Sta., Baltimore, Md.

**Feb. 5-12, 1917.**—AMERICAN ROAD BUILDERS' ASSOCIATION. Seventh American Good Roads Congress and Eighth National Good Roads Show, Mechanics' Hall, Boston, Mass. Secretary, E. L. Powers, 150 Nassau street, New York City.

### Society for Street Cleaning and Refuse Disposal of United States and Canada.

The second annual convention of this society is to be held in the assembly room of Department of Street Cleaning Building, 140 West 20th street, New York City, on October 13 and 14, 1916.

The program and order of business follow:

Friday, October 13.

10 A. M.—Call to order by President J. T. Fetherston. Address of welcome, Hon. Nelson P. Lewis, chief engineer, Board of Estimate. Response, Vice-president G. B. Wilson, Toronto, Canada. Roll call of members. President's report. Secretary-treasurer's report. Appointment of special committees. Introduction of amendments and resolutions.

2 P. M.—Call to order. "Street Cleaning by the Wet System," Vice-president G. A. Hanna, Cleveland, Ohio; "Street Car Flushers," Hon. A. T. Rhodes, Worcester, Mass.; "Hand Sweeping," Hon. Richard T. Fox, Chicago, Ill.; "The New York Anti-Litter League," Hon. R. Ross Appleton, treasurer of league; "A Day's Work," (Motion Picture), Gaumont Film Company.

Saturday, October 14.

9 A. M.—Inspection of School of Instruction, Model District Building, 19th street and East River.

10 A. M.—Call to order. Reports of special committees. Election of officers. "The Horse in Street Cleaning Work," Dr. D. J. Mangan, D. S. C., New York; "Accidents and Diseases,"

Dr. S. I. Rainforth, D. S. C., New York; "Control of Material and Supplies," Mr. A. Schreiner, D. S. C., New York. Inspection of storehouse.

2 P. M.—"Testing Apparatus," Hon. John F. O'Toole, Pittsburgh, Pa.; Paper, Hon. A. W. Miller, Chicago, Ill. Review, President Fetherston. Final action on reports. Miscellaneous.

### American Chemical Society and American Electrochemical Society.

The fifty-third annual meeting of the American Chemical Society, Sept. 25-30, and the full meeting of the American Electrochemical Society, Sept. 27-30, were held during the week of the Second National Exposition of Chemical Industries, which was shown in Grand Central Palace. Many technical and social features marked the meetings.

The exposition was officially opened 2 p. m., Monday, with addresses by Mr. Chas. H. Herty, Mr. Francis A. J. Fitzgerald and Mr. Arthur B. Daniels. At the general meeting of the Chemical Society held at Columbia University, Mayor Mitchel and President Butler of Columbia delivered addresses of welcome. At a public meeting on Tuesday afternoon addresses were made by speakers of national reputation, including Brig.-Gen. William Crozier, chief of ordnance of the U. S. army.

Wilder D. Bancroft read a paper on "Colloid Chemistry," which subject was also the topic of two symposia. Among other papers on Wednesday was one by Mr. Lucius P. Brown, of the New York health department, on the chemistry of milk. He said that chemistry is fundamental in milk, but that legislation had far outstripped knowledge on the subject, as a result of which "some States now have laws that would give cows nervous prostration if they were informed of the demands made upon them." Dr. Brown explained the method by which chemists ascertain the amount of fats in milk, and presented the results of 200,000 analyses of milk that had been made in New York.

While dye-stuffs, paper and explosives naturally were the most prominent topics discussed, gasoline and possible substitutes received attention in a number of papers. In the discussion on the paper supply, Dr. Hugh P. Baker, dean of the State College of Forestry at Syracuse University, said that a great area of New York was idle land which ought to be utilized, and that a large part of it could be made productive for paper manufacturers. From 60 to 70 per cent of the state of Maine, where there were many forests that could be made to produce great quantities of wood pulp for paper making, should be similarly used, he said.

On Friday one of the features was a symposium on "Occupational Diseases in Chemical Trades."

Among the papers presented before the American Electrochemical Society were:

"The Protection of Iron by Electroplating," by O. P. Watts and P. L. De Verter.

"Atmospheric Corrosion of Commer-



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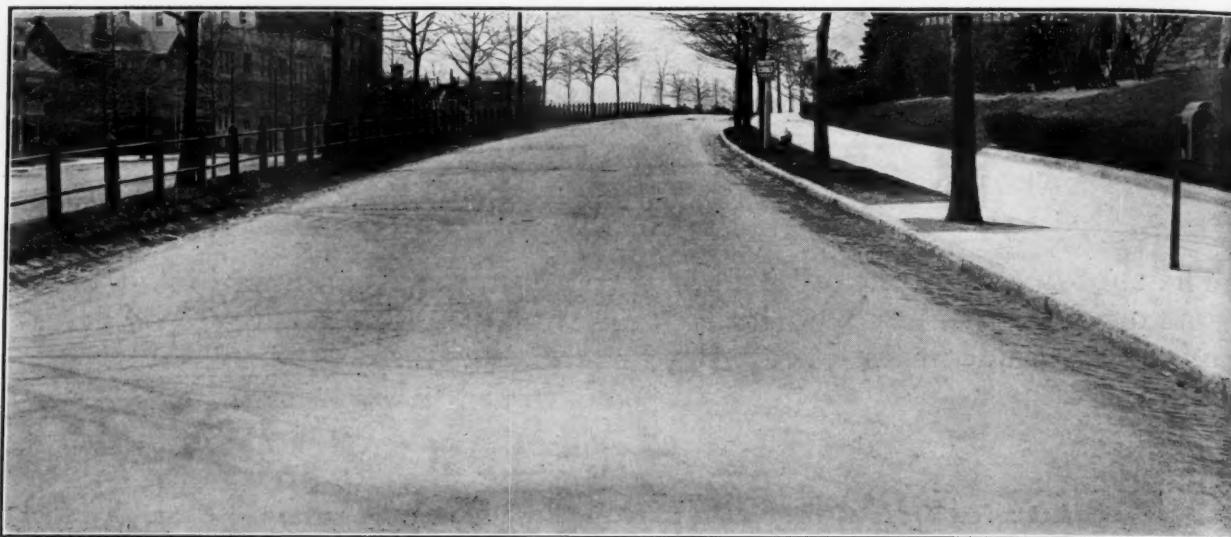
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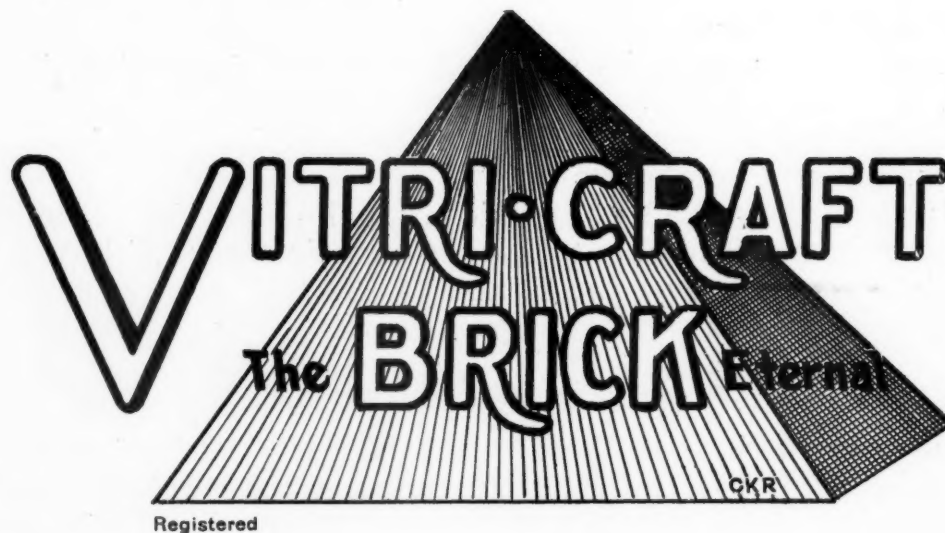
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cial Sheet Iron," by E. A. and L. T. Richardson.

"Characteristics of Small Dry Cells," by C. F. Burgess.

"Effect of Temperature on the Performance of the Edison Storage Battery," by L. C. Turnock.

"The Possibilities of Developing Superrefractory Materials for Incandescent Lighting," by F. A. Fahrenwald.

So elated were the visiting chemists with the success of their second exposition that plans have already been started for an exposition on a considerably larger scale in the Palace next year. Arrangements were made yesterday to add another floor to the exposition space next year, making room for many additional exhibits.

During the week 1,905 chemists from all parts of the United States registered at the Chemists' Club on East 41st street, but only a small part of the visitors called at the club and registered, and it was estimated that the exposition and meetings had attracted to the city about eight thousand chemists, of whom a large number brought members of their families and guests.

Among the exhibitors at the exposition were:

Atlantic, Gulf & Pacific Company, New York City.

The Barrett Company, New York City.  
Barber Asphalt Paving Company, Philadelphia, Pa.

The Bristol Company, Waterbury, Conn.

The Central Foundry Company, New York City.

E. I. Du Pont De Nemours & Co., Wilmington, Del.

Electro Bleaching Gas Company, New York City.

The Foxboro Company, New York City.

General Electric Company, Schenectady, N. Y.

Great Western Power Company, San Francisco, Cal.

Lead Lined Pipe Company, Wakefield, Mass.

Life Saving Devices Company, New York City.

J. L. Mott Iron Works, New York City.

Pennsylvania Salt Mfg. Company, Philadelphia, Pa.

Precision Instrument Company, Detroit, Mich.

Pittsburgh Testing Laboratory, Pittsburgh, Pa.

Research Corporation, New York City.

Stone & Webster Eng. Corp., Boston, Mass.

Thwing Instrument Company, Philadelphia, Pa.

Toch Bros., New York City.

United Lead Company, New York City.

U. S. Bureau of Mines, Bureau of Standards, Bureau of Foreign & Domestic Commerce and Bureau of Census.

United Gas Improvement Company, Philadelphia, Pa.

United Cast Iron Pipe Foundry Company, Burlington, N. J.

There were two very interesting exhibits by the city of Newark, N. J., and Baltimore, Md. Newark showed its port terminal development and Baltimore presented a fine colored model relief map of the city and numerous photographs showing its commercial and civic possibilities and accomplishments.

## PROBLEMS CITIES ARE STUDYING WITH EXPERTS

New SEWERS are to be constructed by Griswold, Ia., from plans and specifications drawn up by J. A. Mayne, Council Bluffs, Ia.

In constructing a SEWAGE DISPOSAL plant, New Lisbon, Wis., had plans and specifications prepared by W. G. Kirchoffer, Madison, Wis.

Wayne county, Richmond, Ind., in considering the type of a new BRIDGE, had the consulting engineering services of J. L. Harrington, Kansas City, Mo.

Highland, Kans., is to improve its WATER WORKS, W. B. Rollins & Co., 439 Railway Exchange Building, Kansas City, Mo., being engineers on the work.

A SEWER SYSTEM is a proposed improvement for Thomaston, Conn., which has retained C. H. Preston, Jr., 136 Grand street, Waterbury, Conn., as engineer.

Emmetsburg, Ia., is constructing new SEWERS for which plans and specifications were prepared by Marr, Green & Co., engineers, 17 N. LaSalle street, Chicago, Ill.

The cities of Quanah and Seymour, Tex., are to have new sanitary SEWER SYSTEMS and DISPOSAL PLANT, Henry Exall Elrod, Interurban Building, Dallas, Tex., having been retained to design and supervise both projects.

The city of Rosedale, Kans., is to build a SEWER SYSTEM at a cost of \$400,000. Plans for the work have been completed by the engineers, Harrington, Howard & Ash, Orear-Leslie Building, Kansas City, Mo.

Clarion, Pa., is to issue bonds for a SEWERAGE SYSTEM and has retained Chester & Fleming, Union Bank Building, Pittsburgh, Pa., as engineers.

Albany, Mo., is to construct a SEWER SYSTEM and DISPOSAL PLANT. The engineers on this work are E. T. Archer & Co., 514 New England Building, Kansas City, Mo.

Dravosburg, Pa., is to install new SEWERS, R. C. Bayne, McKeesport, Pa., having completed the plans and specifications.

A SEWAGE DISPOSAL PLANT is to be constructed by Youngville, Pa., from plans and specifications drawn up by Clyde C. Hill, North East, Pa.

Petoskey, Mich., is to make improvements to its WATERWORKS. The Fargo Engineering Company, 226-28 W. Main street, Jackson, Mich., has plans in progress.

Harmony, Pa., is to build a new WATERWORKS system from plans and specifications drawn up by Douglass & McKnight, Union Bank Building, Pittsburgh, Pa.

## National Safety Council.

The National Safety Council, an employers' organization, was started a little less than three years ago in the United States for the purpose of establishing a clearing house of information on accident prevention, sanitation, health conservation, etc. A remarkable result has come about; starting with 40 members the council now has more than 2,200 and has extended its influence to many foreign countries. The unique feature of the council's service is five bulletins a week to each member—250 per year—transmitting to the employer the very best means and methods of reducing accidents.

The annual meeting and congress of the National Safety Council will take place in Detroit, October 17 to 20. The development of the council's work has indicated the need for intensive study of

(Continued on page 440.)

## PERSONALS

Couzens, James, has been appointed police commissioner of Detroit, Mich., by Mayor Marx, following the resignation of John Gillespie.

Kasseer, E. S., has been elected president of the Denver Union Water Company, succeeding W. P. Robinson, who becomes chairman of the board.

Larsh, L. M., former mayor of Hamilton, O., died Sept. 21 after an illness of two weeks.

Mugan, John E., city marshal, of Ocean Side, Cal., was shot and killed in an altercation with Patrick Burke, deputy sheriff and night watchman.

Sullivan, Dennis, a prominent retired contractor, who was active in politics in Queens borough, New York City, for a number of years, died Sept. 25. He was born in Rochester in 1840. Mr. Sullivan built many gas plants in the city and also a trolley line. For a number of years he was president of the village of Flushing. In 1875 Mr. Sullivan supervised the building of the Flushing water works. Mr. Sullivan built all of the main sewers in Flushing and for seventeen years served as a county detective. He was also a volunteer fireman.

Sweeney, James, chief inspector of the Tenement House Bureau of Brooklyn, New York City, died Sept. 30, in his eightieth year. He was active in his duties until his last illness some months ago. He served under Mayors Wurster and Schieren, of Brooklyn, before the consolidation.

Woody, Howard L., who was superintendent of Public Buildings and Offices in Brooklyn, N. Y., under Borough Presidents Steers and Pounds, died at Sound Beach, Conn., on September 17. He had reached his forty-seventh year. Mr. Woody was born and educated in Fountain City, Ind., and came to Brooklyn twenty-five years ago. Later he became a member of the firm of George Doyle & Co., dealers in building stone. Mr. Woody was elected to the Assembly in 1902 and served for two terms.

# NEW APPLIANCES

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations.

## CARBIC FLARE LIGHT.

### Portable Torches for Night Construction Work.

In construction and emergency operations where night work is necessary to avoid fines or gain bonuses, or to get the work done, adequate lighting of the job is essential. Such lighting should be simple, safe, powerful, portable and reliable. The Carbic flare light has been developed for just such use and it is claimed has eliminated the disagreeable features in using ordinary lump carbide.

The Carbic flare light consists of only three parts—tank, gas bell and cake holder. All parts are made of heavy galvanized steel and brass, substantially built to withstand hard usage. Each light is equipped with a special steel backed aluminum reflector. A novel swivel joint arrangement permits the swinging of the reflector to any desired angle. The burner is wind and storm proof and built to last, with ordinary attention.

The fuel used is Carbic cakes and water. The cakes are made from high grade, gas-producing materials, compressed into briquet form. Each cake is packed separately in waxed paper and will not deteriorate. Carbic is packed in strict accordance with fire underwriter's rules in sheet metal drums. The cakes are made in various sizes for different sizes of apparatus, the diameter ranging from about four to one and a half inches.

The flare light operates automatically and requires practically no attention for continuous operation other than recharging. The gas pressure in the torch remains uniform throughout operation and no pumps or moving parts are needed to maintain pressure. For recharging, it is claimed, only one-third the time required by other flare-lights is needed. Under ordinary conditions the water will not freeze, this being prevented by generation of the gas. In extremely cold weather calcium chloride may be used to avoid freezing. The uniform generation of gas and the very small amount of stored gas in the machine at any one time make for safety. The flame of the Carbic, it is said, consumes very little oxygen from the air and therefore does not vitiate the atmosphere, making this light desirable for underground work.

Economy is aided by the uniform generation, as at no time can wasteful or excessive over-generation occur. The light may be used intermittently and any unused Carbic in the cake holder when the light is turned off is left without appreciable loss from after-generation. While Carbic is higher in price

than ordinary lump carbide, it is cheaper per hour of service and claimed to be simple and more efficient to handle. Distribution is through numerous dealers from adequate stocks and service includes frequent inspection of all apparatus. Cost of operation is less than five cents per hour.

No. 1 and No. 2 special lights produce upwards of 2,000 candle-power and burn 6 hours on two No. 20 Carbic cakes. Reflectors are 13 inches in diameter and 5 inches deep. The overall heights are 6 ft. 5, and 6 ft. 10 inches respectively, and the weights empty, 34 and 43 lbs., and charged 74 and 125 lbs. The No. 2 standard light is most adaptable for general purposes and is similar to the other No. 2 except that the light may be swung down to the side of the tank. No. 3 has two 13-inch reflectors. The "Cadet" light is especially designed for fire department and emergency use where a compact, light weight outfit giving a powerful long beam is required. It is so constructed that it can be carried in the hand or on the back, and has a special swivel joint for the light. It is provided with a tight cover to prevent splashing of water and a novel side vent arrangement eliminates the forming of gas pressure. The light will penetrate fog, smoke and steam.

The cuts on the next page show a No. 2 standard light and the light ready to be charged. The lights are made by the Carbic Manufacturing Company, Duluth, Minn.

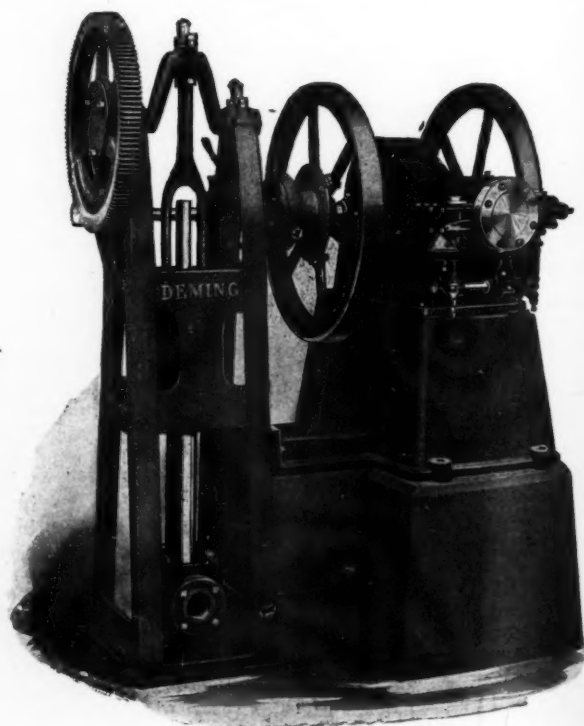
## DEMING PUMPS.

### Of Various Types, Capacities and Sizes for Water Works Service.

Deming power pumps are made in a wide range of styles and sizes to suit the wide range of conditions of power facilities and capacity requirements. Triplex and other power pumps are made for waterworks service, compression, fire service, boiler feeding, hydraulic pressure, etc., with belt, electric motor, gas or gasoline and water wheel drives. Centrifugal pumps for belt or electric drive are made for contractors' use and for pumping large quantities of water against low heads, where efficiency is not an essential. Deep well pumps are made in both the triplex type for open wells and single cylinder type for drilled wells. Any source of power may be used for these pumps.

The Deming triplex pumps embody the principle of the three-throw crank shaft, with the crank pins at an angle of 120 degrees with each other, by which arrangement the strokes follow and overlap one another. This results in a continuous and uniform action, and insures an easy flow through the delivery pipe, with a corresponding high degree of efficiency in the operation of the pump. All of these triplex pumps, whether of the low service, medium or heavy pressure types, have the plungers with crossheads outside guided, thereby relieving the stuffing-box glands of lateral pressure due to the side thrust of the connecting rods.

DEMING  
DEEP WELL  
PUMP WITH  
ENGINE DRIVE.





The main housings, or guide columns, of the geared pumps are of the box girder type, and contain two bearings of extra large dimensions, which support the crank shaft between the cranks. By having two main bearings only, it is easy to keep them in line at all times, which is usually difficult with a bearing on each side of the three cranks, or four main bearings in all, because of the bearings wearing unevenly. Without perfect alignment the shaft will have to be sprung more or less during each revolution, with consequent loss of power.

The crank shaft, of course, is made of high grade of open hearth steel casting in one piece, with all bearings of unusually ample dimensions. Integral



CARBIC FLARE LIGHT.

with the shaft is a large flange, to which is bolted the main gear, giving a design calculated to be superior to that of a shaft of the built-up type. There are no parts to become loosened, or keys to give trouble. If, for any reason, a crank gear has to be replaced, it is not required to take the shaft apart, which usually involves a great amount of labor, but it is only necessary to disconnect the crank end of one connecting rod, remove a few nuts from the bolts which fasten the gear to the crank shaft flange, slip the gear from its place and reverse the operation with the new gear. All this can be done, in most cases, without removing the shaft from its bearings, and requires but a few minutes of time. This method of connecting crank shaft and gear is patented. This type of gear and crank connection is also in the deep well and other pumps having a single crank only.

The gears are provided with a large central flange, which is accurately recessed to gauge to fit over the flange on the crank shaft. They are made of high grade cast iron of high tensile strength, and have machine cut teeth of involute form.

The connecting rods, with the exception of those on pumps of smaller sizes, are made with boxes of marine type at the crank end, and with bronze boxes in halves, with wedges and screw adjustment, at the crosshead end. In the smaller sizes the rods have removable bronze bushings in the crosshead ends.

The plungers, in all pumps, are of the outside guided type, and are provided with crossheads which, except in the

smaller sizes, have bronze shoes admitting of adjustment for taking up wear. The construction also is such that the crosshead pins are continually submerged in a bath of oil. The crossheads run in guides which are bored to a true circle.

The water cylinders are provided with deep bolted gland stuffing boxes, packed from the outside, and in double-acting pumps have removable bronze liners. The valve chambers, except in the smaller sizes of pumps, are separate from the cylinders, and are bolted to them. They have exceptionally large valve areas, and each group of suction and discharge valves is easily accessible through large hand holes having removable covers. Suction and discharge connections may be made at either or both ends of the pump, thus making them adapted to almost any location.

The accompanying illustrations show an example of a double-acting triplex pump and a deep well power working head. The triplex pump is shown arranged for a type "B" drive, with electric motor. The motor is connected to the pump by intermediate gear and rawhide motor pinion and the drive is specially suitable for installations where space is limited. The illustration shows the design for capacities of 723 and 889 gallons per minute, but the same type of pump is also made in smaller sizes with capacities ranging from 111 to 577 gallons per minute. The maximum working pressure is 150 pounds in every size except the 577 gallon, in which it is 140.

The type of deep well pump shown is designed for well depths from 350 to 120 feet with the single-acting cylinders and 265 to 90 feet with the double-acting cylinders. The illustration shows connection for horizontal gas or gasoline engine. The frame consists of two cast-iron standards bolted to the base below and to the rod guide in such a manner as to secure very rigid construction. The rod guide is easily removable, thus affording clear space for the with-

drawal of sucker rods without removing the main frame. Bearings for crank and pinion shafts are of large size and babbitted. Crank shaft is of open hearth steel casting, bearing is machine cut, the main gear being bolted to a large flange which is integral with the crank shaft. Connecting rod is of steel with marine type babbitted box at the crank end, while the cast head pin works in a bronze bushing. Differential plunger is of cast iron, working through outside packed stuffing box, and equalizes the flow of water.

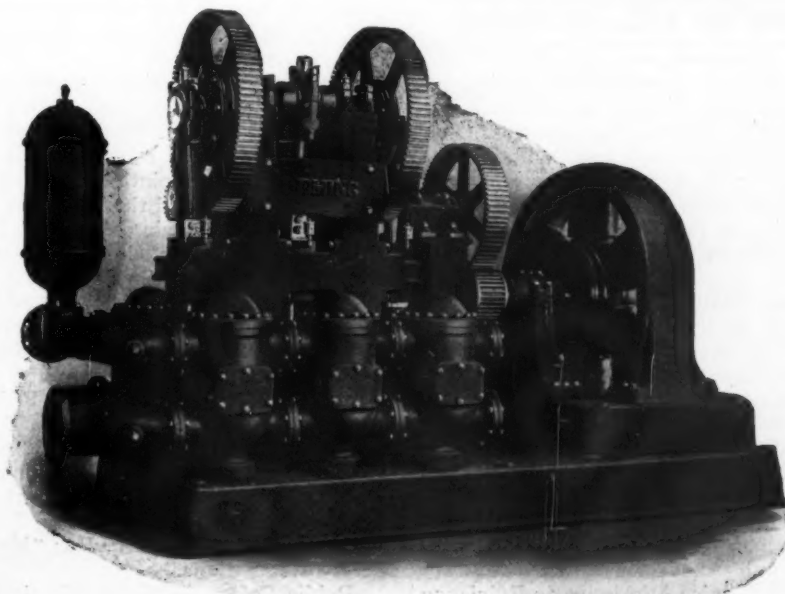
The pumps are made by the Deming Company, Salem, O.

#### Vacuum Street Sweeper.

The California street sweeper made by W. E. Baxter, 500 East 3rd street, Los Angeles, Cal., which was described in these pages in the September 7 issue, was stated as having a capacity of  $2\frac{1}{4}$  cubic feet instead of cubic yards. The cost of operation should have been given as  $10\frac{1}{2}$  cents per 1,000 square yards instead of square feet, as appeared in the article.

## INDUSTRIAL NEWS

**Cast Iron Pipe.**—Chicago—Recent lettings of pipe have been, with one exception, very small. At Chicago, award has been made to contractors of 700 tons of special pipe. Quotations: 4 inch, \$34.50; 6-inch and larger, \$31.50; class A, \$1 extra. Birmingham—The most notable order received recently was for 1200 tons of 4-inch pipe for El Paso, taken by the leading interest. Prices have advanced and shipments are keeping pace with the production. Quotations: 4-inch, \$29; 6-inch and upward, \$26; 16-foot lengths, \$1 extra. New York—General business is of moderate volume, marked by no heavy purchases, while municipal lettings are almost completely absent. Some of the largest private buyers of pipe are sounding the market for prices for delivery next year.



DEMING TRIPLEX PUMP WITH ELECTRIC DRIVE.

Manufacturers are more willing to sell for delivery this fall than to take contracts for 1917, being quite confident that prices will attain a higher level in the not distant future. Quotations: 6-inch, class B and heavier, \$31.50; class A, \$32.50.

**Lead.**—Lead is quiet but steady. Quotations: New York, 7c.; St. Louis, 6.85c.

**The National Paving Brick Manufacturers' Association**, Engineers' Building, Cleveland, O., has published two sets of specifications covering the construction of vitrified brick street pavements, with cement grout filler, green concrete foundation type, and vitrified brick street pavements and highways with cement grout filler, sand-cement superfoundation type. These treat in specification form of every detail of construction according to the most approved methods which are the result of careful experiment. The specifications are well illustrated to bring out important items.

**The Walter A. Zelnicker Supply Co.**, St. Louis, Mo., has issued a new 40-page bulletin, No. 207, describing the latest offerings in contractors' and all kinds of construction equipment, including asphalt plants, boilers, bridges, buckets, dump cars, garbage cars, tank cars, air compressors, cranes, concrete mixers, crushers, steam shovels, dredges, steam and gasoline engines, hoisting engines, electric generators, graders, pile drivers, pipe, pipe-cutting machines, pumps, road rollers, tanks and towers, trench machines, wagons, wheel scrapers, etc.

**The John Kline Brick Co.**, Wickliffe, O., is the newest and the thirty-fourth member of the **Dunn Wire-Cut Lug Brick Company's** group of licensees. This is a well-constructed and well-managed plant with a daily capacity of 40,000. Mr. J. C. Kline is president of the company.

## NEWS OF THE SOCIETIES

(Continued from page 437.)

the problems of various industries, so that the main feature of the meeting this year is sectional conferences. For instance, the electric light and gas industry members will be assembled in the public utilities section, the foundry members in the foundry section, and the cement members in the cement section.

A new feature of the congress this year will be a mammoth safety exhibit, where the latest types of safety devices will be shown.

Some of the section programs are given below:

### Health Service Sectional Meeting.

**Wednesday, October 18, 2 to 5 p. m.**—Program includes report of chairman, report of secretary, reports of committees, appointment of nominating committees and addresses, as follows: "Health Service Works as an Efficiency Factor," Dr. Otto P. Geier; "Health

Education," Dr. L. G. Shoudy, Chief Surgeon, Bethlehem Steel Co., So. Bethlehem, Pa.; "Physical Examination of Employees," Dr. Wilbur E. Post, Chief Medical Adviser, Peoples' Gas, Light & Coke Company, Chicago; "First Aid," Dr. J. C. Bloodgood, Medical Dept., Johns Hopkins University, Baltimore, Md.; "Occupational Diseases," Dr. E. R. Hayhurst, Director, Division of Industrial Hygiene, Ohio State Board of Health, Columbus, O.; "Health Insurance," A. W. Whitney, Gen. Mgr., National Workmen's Compensation Service Bureau, New York City.

**Thursday, October 19, 1916, 2 to 5 p. m.**—Addresses: "The Company Doctor," Dean Samuel S. Marquis, Dept. of Education, Ford Motor Co., Detroit, Mich.; discussion, Mrs. Lillian Burt, American Issue Publishing Co., Columbus, O.; "Employment, Medical Supervision and Safety," L. A. Phelps, Supt., Insurance and Maintenance, The Avery Company, Peoria, Ill.; discussion, J. H. Weller, Supervisor of Labor, Packard Motor Car Co., Detroit, Mich.; "Industrial Hospital and Dispensaries," Dr. R. C. Cabot, Boston, Mass.; discussion, Dr. T. R. Crowder, Chief Surgeon, The Pullman Co., Chicago; Dr. H. N. Torrey, Surgical Director, Michigan Workmen's Compensation Mutual Ins. Co., Detroit, Mich.

**Friday, October 20, 1916, 2 to 5 p. m.**—Four round-table meetings will be held. Thirty minutes' discussion of each topic will follow the addresses. Each speaker will act as the leader of the discussion following his own address. Addresses: "Relationship of Health to Industry," Dr. W. A. Evans, Chicago Tribune, Chicago, Ill.; "Medical Supervision of Workmen," Dr. Harry E. Mock, Chief Surgeon, Sears, Roebuck & Co., Chicago; "Reduction of Health Hazards," Dr. Francis D. Patterson, Chief, Division of Hygiene and Engineering, Pennsylvania Dept. of Labor and Industry, Harrisburg, Pa.; "Standards of Industrial Hygiene," by Dr. J. W. Schereschewsky, U. S. Public Health Service, Pittsburgh, Pa.

### Governmental Sectional Meeting.

**Friday, October 20, 1916, 9.30 a. m. to noon.**—Program includes report of chairman, report of secretary, reports of committees, appointment of nominating committee and the following addresses: "Standardizing Accident Records," Royal Meeker, Commissioner of Labor Statistics, U. S. Bureau of Labor, Washington, D. C.; "The Accident Problem as It Concerns the General Public," Frederick L. Hoffman, Statistician, Prudential Life Insurance Co., Newark, N. J.; "Standardized Federal and State Safety Regulation," E. B. Rosa, Chief Physicist, Bureau of Standards, Dept. of Commerce, Washington, D. C.; discussion, John Price Jackson, Commissioner, Penn. Dept. of Labor and Industry, Harrisburg, Pa.; "Marine Safety Regulations."

### Public Safety Sectional Meeting.

**Friday, October 20, 1916, 9.30 a. m.**

**to noon.**—Program: Report of chairman, appointment of nominating committee, addresses: "Public Safety Work of Public Service Companies," H. A. Bullock, chairman, Central Safety Committee, Brooklyn Rapid Transit Co., Brooklyn, N. Y.; "Ideal Organization for Public Safety in a Community," Robert W. Campbell, chairman, Central Safety Committee, Illinois Steel Co., Chicago; "Street Traffic Regulations as Related to Public Safety," William P. Eno, International Traffic Expert, Saugatuck, Conn.; "Public Safety Education in the Public Schools," R. B. Morley, secretary-treasurer, Ontario Safety League, Toronto, Canada; "Practical Aspects of Public Safety Work," Dr. William Burgess, secretary, Public Safety Commission of Chicago and Cook County, Chicago, Ill.

### American Association of Engineers.

Desirous of exceeding in October the August membership campaign for new men totaling 226, the American Association of Engineers will give a Booster Dinner, October 6, at 6.30 p. m., at the City Club, Chicago.

C. Francis Harding, professor of electrical engineering, Purdue University, will give the principle address, "Marketing Engineering Ability." Other speakers on the program are John Ericson, city engineer of Chicago; W. H. Finley, chief engineer C. & N. W. Ry., and Isham Randolph, consulting hydraulic engineer. All three have recently become members and have promised to tell of lifelong experiences in the selection of engineers.

### Chicago Cement Show.

The Tenth Chicago Cement Show will be held in the Coliseum Wednesday, February 7, to Thursday, February 15, 1917, inclusive.

The concentration of exhibits in the Coliseum, balcony and annex, will enable visitors to inspect them conveniently, as machines and products will be closer together.

There will probably be a joint exhibit of cement companies similar to the one at the last show. It is planned to make the tenth show joint exhibit even more comprehensive, educational and promotional than that of last year and to show, to as large an extent as possible, products in the making.

During the eight day period Chicago will be the center of activity in the building material industry. The National Builders' Supply Association and the Illinois Lumber & Builders' Supply Dealers' Association will hold conventions. While the dates have not been definitely set, it is possible that the American Pipe and Tile Association will be in session during the Cement Show. It is also likely that the American Concrete Institute will meet at the same time. Besides these organizations, it is possible that the American Association of Engineers and other similar associations will convene during the show.



# ADVANCE CONTRACT NEWS

## ADVANCE INFORMATION BIDS ASKED FOR

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information concerning it as early as possible; also correction of any errors discovered.

## CONTRACTS AWARDED ITEMIZED PRICES

### BIDS ASKED FOR

STATE	CITY	REC'D UNTIL	NATURE OF WORK	ADDRESS INQUIRIES TO
<b>STREETS AND ROADS.</b>				
N. Y., New York	.....noon, Oct.	6..	Constructing concrete sidewalks.....	C. D. Van Name, Pres. Boro Richmond.
Ind., Hartford City	.....Oct.	6..	Improving streets; cost, \$4,000.....	City Clerk.
Ind., Indianapolis	.....10 a.m., Oct.	6..	Gravel road construction.....	L. K. Fesler, Marion Co. Aud.
Ore., Portland	.....Dec.	6..	Regrading for railroad work; cost, \$600,000.....	City Engineer.
La., Alexandria	.....Oct.	6..	Constructing 17 miles gravel road, including grading, culverts, bridging.....	Ira W. Sylvester, Engineer.
Ill., Chicago	.....Oct.	6..	Paving streets and alleys with asphalt.....	Board of Pub. Wks.
Miss., Houston	.....Oct.	6..	8 miles gravel road.....	County Commissioners.
Wis., Kenosha	.....9 a.m., Oct.	6..	Constructing sidewalks.....	City Engineer.
N. J., Roselle	.....8 p.m., Oct.	6..	Concrete sidewalks.....	Boro. Engineer, 120 Broad St., Elizabeth, N. J.
N. J., Lodi	.....8 p.m., Oct.	6..	Grading and cement curb gutter and sidewalk.....	J. A. McMahon, Boro. Clerk.
Ind., Lafayette	.....10 a.m., Oct.	7..	Gravel road construction.....	G. W. Baxter, Tippecanoe Co. Aud.
Ind., Rockport	.....3 p.m., Oct.	7..	Water bound rock roads.....	J. F. Stocking, Spencer Co. Aud.
Ala., Birmingham	.....2 p.m., Oct.	9..	Road construction.....	R. L. Bradley, Judge of Pro.
O., Sebring	.....Oct.	9..	Brick pavement and stone curb, cost \$53,000.....	H. C. Stratton, Engr.
Minn., St. Paul	.....10:30 a.m., Oct.	9..	Grading and improvement of streets and alleys.....	H. W. Austin, Pur. Agt.
Cal., Sacramento	.....2 p.m., Oct.	9..	Constructing state highway, about 3.6 miles.....	California Highway Comm.
Ala., Vernon	.....Oct.	9..	Constructing road.....	P. S. Miller, Co. Engr.
N. J., Plainfield	.....8 p.m., Oct.	9..	Restoring 4,770 sq. yds. pavement in connection with sewer construction.....	A. J. Gavett, City Surveyor
N. Y., New Brighton	..Noon, Oct.	9..	2,700 sq. ft. concrete sidewalk.....	Engineer, Bureau of Engineering.
O., Cincinnati	.....Noon, Oct.	10..	Reinforced concrete pavement and concrete curbs and walk.....	Chief Engineer, Dept. Pub. Service.
Pa., West View	.....8 p.m., Oct.	10..	Paving with vitrified block.....	C. A. McClain, Boro. Clerk.
Cal., Ventura	.....Oct.	10..	Furnishing 10,000 bbls. road oil.....	J. B. McCloskey, Clk. Bd. Supv.
D. C., Washington	.....Oct.	10..	Grading and improving streets and roads.....	Dist. Comrs., room 509 District Building
Md., Baltimore	.....noon, Oct.	10..	About one mile sheet asphalt road construction.....	Clyde H. Wilson, Secy. State Road Commission.
Mo., St. Louis	.....noon, Oct.	10..	Improving road with vit. brick pav't and granite curb.....	E. R. Kinsey, Pres. Bd. Pub. Service.
Minn., Crookston	.....2 p.m., Oct.	10..	Highway grading.....	H. J. Welte, Polk Co. Aud.
N. J., Belvidere	.....Oct.	10..	4.12 miles bituminous macadam road.....	F. W. Salmon, Co. Engr., Netcong, N. J.
Md., Baltimore	.....noon, Oct.	10..	One mile sheet asphalt pavement.....	State Roads Comr.
Del., Wilmington	.....noon, Oct.	10..	Concrete curb and foundation and vitrified block pavement for bridge approaches.....	James Wilson, Newcastle Co. Engineer.
N. Y., New York	.....11 a.m., Oct.	11..	Regulating and repaving several streets with asphalt on 6-in. concrete foundation, grading and sidewalks.....	L. H. Pounds, Pres. Boro. Brooklyn.
Ind., Indianapolis	.....10 a.m., Oct.	11..	Curbing, laying sidewalks and constructing retaining wall.....	Board of Park Commissioners.
N. J., Hammonton	.....8 p.m., Oct.	11..	15,911 sq. yds. reinforced concrete pavement.....	J. C. Remington, Jr., Engr., 601 Market St., Camden, N.J.
N. J., Atlantic City	.....noon, Oct.	11..	30,000 gals. glutrin.....	Board of Chosen Freeholders.
Ind., Crown Point	.....1 p.m., Oct.	11..	Constructing gravel road.....	Edward Simon, Co. Aud.
Miss., DeKalb	.....10 a.m., Oct.	11..	Grading and macadamizing 30 miles of road.....	Highway Comrs., Dist. No. 1.
Ind., Indianapolis	.....10 a.m., Oct.	11..	Road construction.....	L. K. Fesler, Marion Co. Aud.
N. Y., New York	.....3 p.m., Oct.	11..	Paving and repaving with sheet asphalt and asphalt blocks, boulevards and park walks.....	Cabot Ward, Pres. Park Bd.
O., Cleveland	.....Noon, Oct.	11..	Grading, curbing and paving.....	Comr. of Engineering.
O., Akron	.....11 a.m., Oct.	12..	Grading, draining, curbing and paving.....	Summit Co. Commissioners.
Ind., Indianapolis	.....10 a.m., Oct.	13..	Paving.....	Board of Park Comrs.
Mass., Boston	.....noon, Oct.	13..	Laying concrete pavement.....	Park & Recreation Dept., 33 Beacon St., Boston.
Neb., Superior	.....2 p.m., Oct.	13..	Grading and paving.....	L. L. Carpenter, City Clerk.
Que., LaSalle	.....5 p.m., Oct.	13..	Constructing macadam and concrete roads.....	Belque and Charlon, Engrs., Transportation Bldg., Montreal.
Ind., Liberty	.....1 p.m., Oct.	14..	Constructing gravel road.....	G. W. Wray, Co. Auditor.
Mich., Houston Lake	.....Oct.	14..	Constructing 3 miles state road.....	J. H. Ostrander, Twp. Clk., Roscommon.
O., Woodfield	.....Oct.	14..	Curbing and paving with vitrified brick.....	G. P. Dorr, Village Clerk.
O., Pomeroy	.....Oct.	16..	Paving with brick.....	W. J. Jones, Village Clerk.
O., Cleveland Heights (Warrens P. O.)	.....Oct.	16..	Paving with brick, asphalt or macadam.....	H. H. Canfield, Village Clerk.
O., Columbus	.....noon, Oct.	16..	Graveling road and constructing fill.....	John Scott, Clk., Co. Comrs.
O., Cleveland Heights	.....Oct.	16..	Paving streets.....	F. A. Pease Engr. Co., Marshall Bldg., Cleveland, O.
Neb., Superior	.....Oct.	16..	Paving alleys.....	City Engineer.
Neb., Omaha	.....noon, Oct.	17..	Brick street paving.....	County Engineer, Douglas Co.
N. J., Woodbury	.....Oct.	17..	Gravel road construction, \$10,000 available.....	W. C. Cattell, Co. Engr., Weonah, N. J.
Neb., Grand Island	.....Oct.	18..	20,000 sq. yds. brick, asphalt or asphaltic concrete pavement, curb, etc. ....	H. E. Clifford, City Clerk

## BIDS ASKED FOR

STATE	CITY	REC'D UNTIL	NATURE OF WORK	ADDRESS INQUIRIES TO
Pa.	Newcastle	11 a.m., Oct. 18.	Reconstructing highway	T. A. Gilkey, Co. Engineer, Mercantile Bldg.
N. J.	Newark	Oct. 19.	Paving with bitulithic on concrete base	Morris Sherrard, Chief Engr.
Fla.	Brooksville	Oct. 19.	Concrete curb and paving	H. McElroy, Tampa, Engineer.
Ala.	Lafayette	Oct. 20.	Grading, draining and surfacing state road	W. S. Keller, St. Hwy. Engr., Montgomery, Ala.
W. Va.	Wellsburg	2 p.m., Oct. 20.	Constructing 10 miles of road	C. A. Nichellberger, Co. Engr.
O.	Cincinnati	noon, Oct. 20.	Road repair	Hamilton County Surveyor.
Ind.	Brazil	10:30 a.m., Oct. 25.	Stone and gravel road construction	W. O. Graeser, Co. Aud.
Pa.	Greensburg	Oct. 29.	3 1/4 miles brick paving and concrete curb	J. S. Bell, Westmoreland, Co. Controller.
Ark.	Texarkana	10 a.m., Oct. 30.	Eight miles asphaltic concrete, asph. mac., vertical fiber brick, concrete and gravel pavements	E. F. Peterson, Engineer.
Kan.	Texarkana	10 a.m., Oct. 30.	Five miles hard surface pavement	E. F. Peterson, Engr., State National Bank Building
SEWERAGE.				
Ia.	Spencer	8 p.m., Oct. 6.	2,500 ft. 8 to 15-in. sewers	E. O'Keeffe, City Clerk.
N. J.	Roselle	8 p.m., Oct. 6.	560 lin. ft. 8-in. vit. sewer, necessary manholes, Y branches and other appurtenances	J. L. Bauer, Boro Engr., Elizabeth, N. J.
Minn.	St. James	2 p.m., Oct. 6.	Constructing two large tile drainage ditches	J. C. Jensen, County Auditor.
Mich.	Lansing	10 a.m., Oct. 6.	Drain construction	E. J. Doane, Co. Comr.
O.	Urbana	Oct. 7.	Constructing sewer system and disposal plant	R. G. Duncan, Clerk, Bd. Education.
O.	Massillon	noon, Oct. 7.	Constructing sanitary sewers	City Engineer.
Wis.	Wauwatosa	1:30 p.m., Oct. 7.	700 ft. 8-in. vit. sewer pipe; 1,060 ft. 42-in. reinforced concrete sewer pipe	City Engineer.
N. Y.	New York	2 p.m., Oct. 9.	Sewer extension and alterations	M. M. Marks, Pres. Boro. Manhattan.
N. J.	Fairview	8:30 p.m., Oct. 9.	Lateral sewer construction	J. F. Lyons, Boro. Clerk.
Pa.	Etna	5 p.m., Oct. 9.	Constructing sanitary sewer	J. C. Armstrong, Boro Clerk.
Pa.	Mt. Pleasant	8 p.m., Oct. 9.	Laying 1,000 ft. 8-in. sewer	A. S. Overholt, Secy.
N. Y.	New York	2 p.m., Oct. 9.	Extending and improving sewers	Comr. of Pub. Works, Bureau of Sewers.
N. J.	Plainfield	8 p.m., Oct. 9.	12,240 ft. 15 to 54-in. sewer	A. J. Gavett, City Surveyor
Ia.	Logan	Oct. 9.	Sewer construction, cost \$20,000	Bruce & Standeven, Engrs., Omaha, Neb.
Mass.	Boston	noon, Oct. 9.	Dredging, filling and sewerage work	E. F. Murphy, Comr. of Pub. Works.
N. Y.	New York	2 p.m., Oct. 9.	Constructing tunnel relief sewer	Comr. P. Wks., Bur. of Sewers.
O.	Cincinnati	noon, Oct. 9.	Constructing several sewers	Chief Engr., Dept. Pub. Serv.
Ia.	Sioux City	2 p.m., Oct. 9.	Tile and open drainage ditches	E. E. Hosmer, Co. Aud.
Neb.	Stanton	7 p.m., Oct. 9.	Constructing several sewers	W. T. McFarland, City Clerk.
Minn.	Benson	10 a.m., Oct. 9.	Tile drainage ditches, cost \$13,100	S. B. Gardner, Engineer, Benson, Minn.
Minn.	Springfield	7:30 p.m., Oct. 9.	360 ft. 8-in. sewer	E. J. Fernholz, Recorder.
N. J.	East Orange	Oct. 9.	Constructing storm water drain	W. D. Willgerod, City Engr.
N. J.	E. Orange	8 p.m., Oct. 9.	Monolithic reinforced concrete segmental and vitrified segment block sewer	L. E. Rowley, City Clerk.
Minn.	St. Paul	10:30 a.m., Oct. 9.	Sewer construction	H. W. Austin, Pur. Agent.
O.	Port Clinton	Oct. 10.	Constructing sewers; cost, \$16,000	K. E. Wedikind, City Engr.
Mo.	St. Louis	Oct. 10.	Sewer construction	E. R. Kinsey, Pres. Bd. P. W.
N. J.	Ridgewood	Oct. 10.	Constructing sanitary sewers	Fred Simonds, Engineer.
O.	Port Clinton	Oct. 10.	Sewer construction	W. H. Williamson, Vil. Clk.
Pa.	West View	8 p.m., Oct. 10.	Sanitary sewer construction	C. A. McClain, Boro Clerk.
O.	Lorain	Noon, Oct. 10.	Two sanitary sewers	Director of Pub. Service.
Wis.	Clintonville	6 p.m., Oct. 10.	Sewer construction	City Clerk.
N. Y.	Albany	noon, Oct. 11.	Constructing sewers and pumping plant in Olean Flood abatement work	W. W. Wotherspoon, Street Supt. Pub. Works.
Pa.	Bellwood	Oct. 11.	Sewerage system and disposal plant	Harvey Linton, Engr., 1717 13th St., Altoona, Pa.
Minn.	Morris	10 a.m., Oct. 11.	Constructing tile drains, cost \$4,400	C. R. Wollthian, County Aud.
Minn.	Morris	2 p.m., Oct. 11.	Constructing tile drains, cost \$10,200	C. R. Wollthian, County Aud.
Minn.	Morris	10 a.m., Oct. 12.	Constructing tile drains, cost \$9,635	C. R. Wollthian, County Aud.
Minn.	Morris	2 p.m., Oct. 12.	Constructing drainage ditches, cost \$8,500	C. R. Wollthian, County Aud.
Wis.	Neeenah	2 p.m., Oct. 12.	3,700 ft. sewer construction	H. S. Zemlock, City Clerk.
Va.	Norfolk	1 p.m., Oct. 12.	Constructing a large amount of sewers	W. H. Taylor, Jr., City Engr.
Wis.	Neeenah	Oct. 12.	Sewer construction	A. E. McMahon, Engineer.
Pa.	Harrisburg	noon, Oct. 12.	Terra cotta pipe sewer construction	W. H. Lynch, Supt. Streets & Pub. Impvts.
Wis.	Neeenah	2 p.m., Oct. 12.	Sewer construction	H. S. Zemlock, City Clerk.
O.	Kirksville	noon, Oct. 13.	Sewer system and disposal plant at school	S. R. Reelhorn, Clk. Bd. Educ.
O.	Woodsfield	Oct. 14.	Sewer construction	G. P. Dorr, Village Clerk.
O.	Cleveland	Oct. 14.	Sewer construction	Board of County Comrs.
O.	Cleveland Heights (Warrens)	Oct. 16.	Sewer construction	Village Clerk.
Mo.	Chillicothe	noon, Oct. 14.	Constructing sanitary sewer	John Williams, City Auditor.
Cal.	Hermosa Beach	Oct. 15.	Disposal plant, cost \$27,000	C. R. Sumner, City Engr.
Minn.	Proctorknott	noon, Oct. 16.	1,080 ft. 6-in. sewer and 3 brick manholes	R. G. Wambacher, Village Rec.
O.	Cleveland Heights	Oct. 16.	Sewers in two streets	F. A. Pease Engr. Co., Marshall Bldg., Cleveland, O.
Minn.	Olivia	2 p.m., Oct. 16.	Constructing tile drainage ditch	T. S. Hewardine, Engr., Olivia.
Minn.	Olivia	3 p.m., Oct. 16.	Tile drains, cost \$26,500	L. C. Vader, Engineer.
N. Y.	Buffalo	11 a.m., Oct. 16.	5-ft. stone water drain and several tile sewers	A. W. Kreinheder, Comr. P. W.
N. J.	Camden	Oct. 16.	Sewer construction	City Clerk.
Minn.	Olivia	10 a.m., Oct. 17.	1,100,000 cu. yds. excavation; laying and furnishing 440,000 ft. of tile	T. S. Hewardine, Engr., Olivia.
N. C.	Tarboro	8 p.m., Oct. 17.	Five miles 8 to 12-in. sewer	J. P. Keech, Mayor.
Cal.	Hermosa Beach	Oct. 17.	Sewage disposal and treatment plant	S. R. Sumner, City Engr.
Wis.	Appleton	9 a.m., Oct. 19.	Constructing sewer in Spring Street	E. L. Williams, City Clerk.
O.	Toledo	Oct. 24.	8-in. vitrified sewer, manholes and catch basins	G. Cooper, Lucas Co. Aud.
Ida.	Emmett	10 a.m., Nov. 2.	Drainage canal and tile drain	Horn & Hays, Engrs., Empire Building, Boise
WATER SUPPLY.				
N. Y.	Port Dickinson	8 p.m., Oct. 6.	Constructing two water mains	R. H. Perkins, Village Clerk.
Tex.	Hamlin	Oct. 6.	Dam and water supply; cost, \$50,000	City Engineer.
O.	Newburgh Heights	Noon, Oct. 6.	Constructing water mains	Ralph Hecker, Engr., Leader-News, Bldg., Cleveland.
O.	Youngstown	Oct. 9.	Extending waterworks system	City Engineer.
Minn.	St. Paul	10:30 a.m., Oct. 9.	Rotary screens for pumping station	H. W. Austin, Pur. Agent.
Ind.	South Bend	10 a.m., Oct. 10.	Constructing water connections	Board of Public Works.